ZOOLOGIA 38: e66300
ISSN 1984-4689 (online)
zoologia.pensoft.net

RESEARCH ARTICLE

Six new species of the widespread Brazilian millipede genus *Eucampesmella* (Polydesmida: Chelodesmidae)

Rodrigo S. Bouzan[1,2], Luiz Felipe M. Iniesta[1,2], João Paulo P. Pena-Barbosa[1], Antonio D. Brescovit[1]

[1]*Laboratório de Coleções Zoológicas, Instituto Butantan, Avenida Vital Brasil 1500, 05503-090 São Paulo, SP, Brazil.*
[2]*Programa de Pós-graduação em Zoologia, Instituto de Biociências, Universidade de São Paulo. Rua do Matão 101, 05508-090 São Paulo, SP, Brazil.*
Corresponding author: Rodrigo S. Bouzan (rodrigobouzan@outlook.com)

http://zoobank.org/492A24F4-9357-440E-BF1F-77D6E440963F

ABSTRACT. This study concerns the diplopod genus *Eucampesmella* Schubart, 1955, widespread in Brazil. After this work, the genus includes 12 valid species, and three incertae sedis: *E. pugiuncula* (Schubart, 1946), *E. brunnea* Kraus, 1959 and *E. schubarti* Kraus, 1957. The type-species, *Eucampesmella tricuspis* (Attems, 1931), is redescribed based on the holotype, and the following six new Brazilian species are added: *Eucampesmella macunaima* **sp. nov.** from the states of Rondônia, Pará, and Piauí; *E. capitu* **sp. nov.** from the states of Piauí and Paraíba; *E. brascubas* **sp. nov.** from the state of Sergipe; *E. iracema* **sp. nov.** from the state of Pernambuco; *E. pedrobala* **sp. nov.** from the state of Ceará; and *E. lalla* **sp. nov.** from the state of Rio Grande do Norte. Furthermore, *E. lartiguei ferrii* (Schubart, 1956) is recognized as a junior synonym of *E. lartiguei lartiguei* (Silvestri, 1897), which also had its status changed, and *E. sulcata* (Attems, 1898) is revalidated, prevailing under the name *Leptodesmus tuberculiporus* Attems, 1898. In addition, drawings, diagnoses, and distribution maps for all species of the genus are provided.

KEY WORDS. Amazon rainforest, Atlantic rainforest, Caatinga, Diplopoda, Neotropical, taxonomy.

INTRODUCTION

The Chelodesmidae is one of the most diverse families of Diplopoda in the Neotropics, with almost 800 described species (Hoffman 1980, Enghoff et al. 2015). Although the variations in the male copulatory organs are traditionally used for species delineation in Chelodesmidae (Pena-Barbosa et al. 2013), the female genitalia has been historically neglected, with only a few published studies mentioning these structures (Hoffman 1990a, 1990b, 2000). Overall, it is not clear if females have been neglected because they lack diagnostic characters or because traditional millipede taxonomy has focused on gonopod characters (Ah-King et al. 2014, Zahnle et al. 2020). The male copulatory organs, the gonopods, are well-exposed and easily recognized, while the female organs are commonly hidden inside the body.

Eucampesmella Schubart, 1955 comprises millipedes that are widespread throughout the North and Northeast regions of Brazil. The included species occur in the following terrestrial biomes: Caatinga, Atlantic Forest and Amazonian Rainforest (Hoffman 1967). Some species also have been reported from human-impacted environments (Schubart 1948, Golovatch and Hoffman 2004). Although widely distributed, few studies have focused on the composition of the genus and its ecology. Hoffman (1967) recognized five species and one subspecies, besides highlighting the uncertain status of the two species from Peru (*E. brunnea* Kraus, 1959, and *E. schubarti* Kraus, 1957) and one from the state of Amazonas, Brazil: *E. pugiuncula* (Schubart, 1946). To date, nine species have been placed into the genus: *E. tricuspis* (Attems, 1931) from Brazil; *E. sulcata* (Attems, 1898), *E. lartiguei ferrii* (Schubart, 1956), *E. serrana* (Attems, 1944) from state of Bahia, Brazil; *E. expansa* (Brölemann, 1903) and *E. lartiguei lartiguei* (Silvestri, 1897) from state of Pernambuco, *E. janetae* Golovatch & Hoffman, 2004 from state of Amapá; and the three species previously mentioned: *E. pugiuncula* from Amazonas; and *E. brunnea* Kraus, 1959 and *E. schubarti* Kraus, 1957 from Peru.

The present study provides a redescription of the type-species of *Eucampesmella tricuspis*, and describes six new species of *Eucampesmella*. Furthermore, *E. lartiguei ferrii* is recognized as junior subjective synonym of *E. lartiguei lartiguei*, which also had its status changed. Also, *E. sulcata* is revalidated, while *E. tuberculipora* is considered its junior synonym. Drawings, diagnosis, and distribution maps for all species of the genus are also provided.

MATERIAL AND METHODS

The examined specimens are deposited in the following collections (curators in parenthesis): CHNUFPI, Coleção de História Natural da Universidade Federal do Piauí, Floriano, Brazil (E.F.B. Lima); IBSP, Instituto Butantan, São Paulo, Brazil (A.D. Brescovit); ISNB, Institut Royal des Sciences Naturelles de Belgique, Brussels, Belgium (J. Constant); IEPA, Instituto de Estudos e Pesquisas Tecnológicas do Amapá, Macapá, Brazil (J.M.F. Gama); MNRJ, Museu Nacional do Rio de Janeiro, Rio de Janeiro, Brazil (A.B. Kury); MPEG, Museu Paraense Emílio Goeldi, Belém, Brazil (A.B. Bonaldo); MHNG, Museum d'Histoire Naturelle, Geneva, Switzerland (P. Schwendinger); MZSP, Museu de Zoologia, Universidade de São Paulo, São Paulo, Brazil (R. Pinto da Rocha); NHMW, Naturhistorisches Museum Wien, Wien, Austria (N. Akkari); SMF, Forschungsinstitut und Natur-Museum Senckenberg, Frankfurt, Germany (P. Jäger); UFMG, Universidade Federal de Minas Gerais, Belo Horizonte, Brazil (A.J. Santos); UFPB, Universidade Federal da Paraíba, João Pessoa, Brazil (M.B. Silva); VMNH, Virginia Museum of Natural History, Vírginia, USA (K. Ivanov); ZMH, Zoologisches Museum Hamburg, Hamburg, Germany (D. Harms); ZMUM, Zoological Museum of the Moscow State University, Moscow, Russia (A.A. Schileyko).

Morphological observations and illustrations were obtained using a Leica MZ12 stereomicroscope with camera lucida. Scanning electron micrographs were acquired at the Laboratório de Biologia Celular do Instituto Butantan using a FEI Quanta 250 SEM with a digital SLR camera attached. All measurements are in millimeters. Gonopod terminology follows Pena-Barbosa et al. (2013). Vulva terminology follows Koch (2015). Geographic coordinates were obtained using Google Earth (Lat/Long – WGS84) and species distribution maps were made using the DIVA-GIS 7.5 program. Morphological abbreviations: (A) acropodite, (AP) acropodital process, (C) cannula, (Cx) coxae, (EV) external valve, (IV) internal valve, (PfP) prefemoral process, (Op) operculum, (S) solenomere, (SG) spermatic groove, (SPr) secondary process of the prefemoral process.

TAXONOMY

Chelodesmidae Cook, 1895

Chelodesminae Cook, 1895

Macrocoxodesmini Hoffman, 1990

Eucampesmella Schubart, 1955

Eucampesmella Schubart, 1955: 509; Hoffman, 1967: 185; Golovatch and Hoffman, 2004: 51. Type-species: *Pseudoleptodesmus tricuspis* Attems, 1931, by original designation.

Diagnosis. Males of *Eucampesmella* differ from all other genera of the Chelodesmidae by the massive and prominent gonocoxa (Fig. 16); prefemoral region basally separated (= basal constriction Hoffman, 1967) from the acropodite region (Figs 17, 18, arrows); by having a well-developed prefemoral process with a secondary process (Fig. 15), varying in shape and position among the species of the genus; a well-developed shield-shaped process in the acropodite region covering the solenomere (Figs 15, 16). Females of *Eucampesmella* differ from all other genera of Chelodesmidae by having vulvae elongated and slender (Fig. 21); small operculum (Figs 21–23); and the posterior margin of vulvae opening with large epigyne (Fig. 20, arrow), except for *Eucampesmella brascubas* sp. nov. and *E. lalla* sp. nov. with an epigyne half as long.

Description. General characters: body length between 40 mm (*Eucampesmella tricuspis*) and 63 mm (*E. lalla* sp. nov). Coloration: living specimens black with tip of paranota yellow (Fig. 2); animals preserved in 70% ethanol range from black to reddish and brown, with paranota whitish (Figs 25–27). Head: smooth, with three pairs of setae between the antennae (row 0, 1 and 2), more setose near the mouth parts (Fig. 5). Gnathochilarium: without modifications as observed in other Chelodesmidae, but covered by short and thick setae (Fig. 9). *Incisura lateralis* rounded (Fig. 6). Antennae: seventh antennomere having two well-demarcated invaginations and two slight invaginations of the exoskeleton between the sensory cones; modified setae arranged into two small groups; very small setae on the ectal side of the antepenultimate antennomere (Figs 7, 8). Some species with the last antennomere yellow. Body ring: cuticle slightly rough, without projections, tubercles or setae (Fig. 11). Collum: anterior border arched and posterior border straight, without modifications; corners rounded. Stigma oval, almost flat (Fig. 12). Sternites: 4th body ring with a pair of projections, the 5th body ring with two or one pair of projections, 6th and 7th body rings with a pair of processes in some species. Ozopore arrangement 5, 7, 9, 10, 12, 13, 15-19 (following the normal polydesmidan pore formula); ozopores surrounded by a peritremata and with a slightly pronounced rounded rim (Fig. 11). Paranota: prominent rounded, without projections (Fig. 11). Legs: anterior legs with ventral setae more dense than the dorsal setae (Fig. 10); anterior legs also more setose, when compared to posterior legs; presence of a pronounced dorsal lobe on the prefemur and in some species granules on the tibia. Telson: triangular, with five pairs of macrosetae on the dorsal sides and two pairs on the apical region.

Male characters. Gonopore: coxae of second pair of legs with a subrectangular shape, bearing a ventral pore (= genital papilla). Gonopod aperture on body ring 7: elliptical, with a sclerotized gonopod support base and with posterior margin excavated; folds at the lateral sides of posterior border (Fig. 13). Posterior border prominent ventrally developed in some species (Fig. 14). Gonopods: well-developed, with massive gonocoxae (Figs 16, 17). The gonocoxae protrude laterally so much that the prefemur is largely obscured. Cannula robust and hook-shaped (Figs 15, 18). Prefemoral region setose and ventrally positioned; prefemoral region and acropodite region clearly demarcated [basally separated] (Figs 16–18). Prefemoral process well-developed,

Figures 1-4. *Eucampesmella macunaima* sp. nov.: (1) place where the specimens were found; (2) live specimen; (3–4) living adults mating. Photos courtesy of Raphael Indicatti.

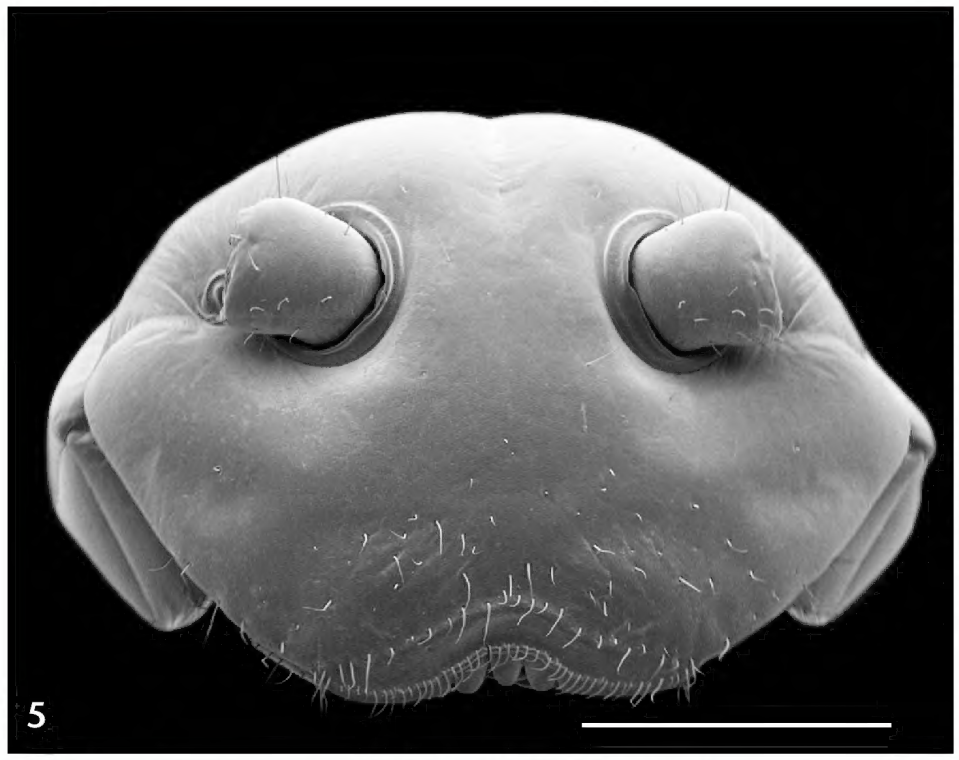
containing a secondary projection, varying in shape, position and length (Fig. 15); solenomere protected by shield-shape process at the acropodite region (Figs 15, 16).

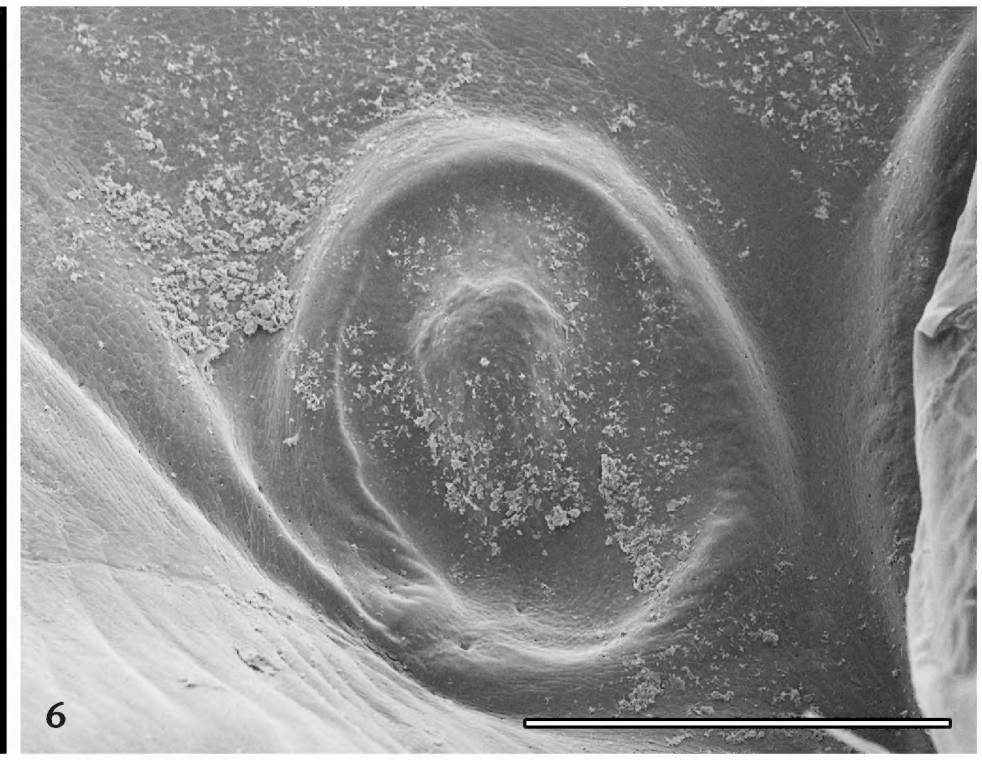
Female characters. posterior margin of vulvae opening presenting an epigyne, in most of the species this structure is well-developed (Fig. 20, arrow). Vulvae: easily observable, protruding out of the body (Fig. 19); situated directly behind second pair of legs of third body ring; long and well developed (Figs 21, 22), composed of three valves, all densely setose (Fig. 24); internal (IV) and external (EV) valves joined by an intermediate membrane (Figs 21, 22), with a proximal and small operculum adpressed against both larger valves (Op, Figs 21–23).

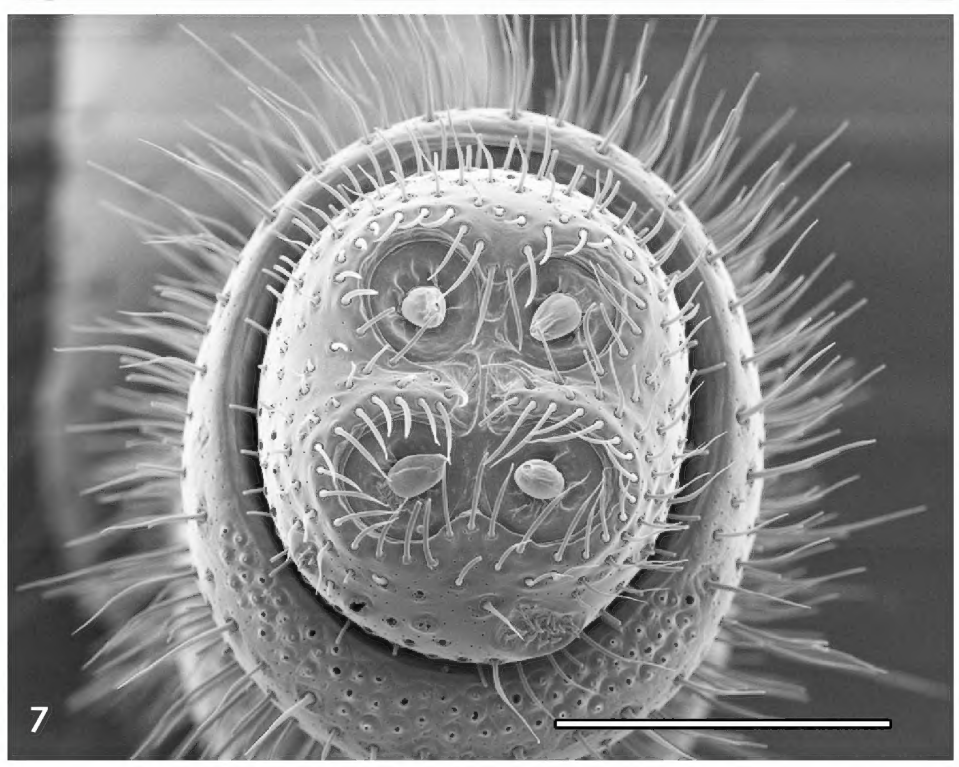
Distribution. Known from the Brazilian states of Amapá to Bahia, occurring in the Caatinga, Atlantic Forest, and Amazonian Rainforest (Figs 66, 67).

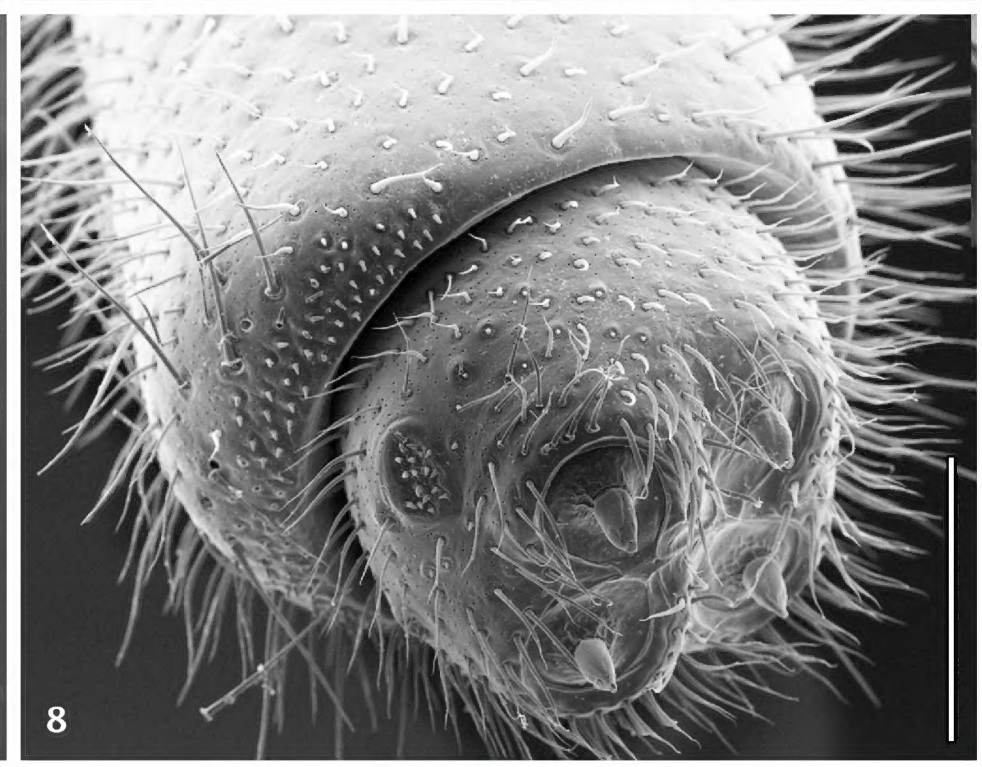
Composition. Twelve valid species (and three Incertae sedis, see discussion on section "Incertae sedis Species" on page 19). Six species previously described: *Eucampesmella tricuspis* (Attems, 1931), *E. sulcata* (Attems, 1898) stat. rev., *E. lartiguei* (Silvestri, 1897), stat. nov., *E. expansa* (Brölemann, 1903), *E. serrana* (Attems, 1944), *E. janetae* Golovatch and Hoffman, 2004, and six new species: *Eucampesmella macunaima* sp. nov., *E. capitu* sp. nov., *E. brascubas* sp. nov., *E. iracema* sp. nov., *E. pedrobala* sp. nov., and *E. lalla* sp. nov.

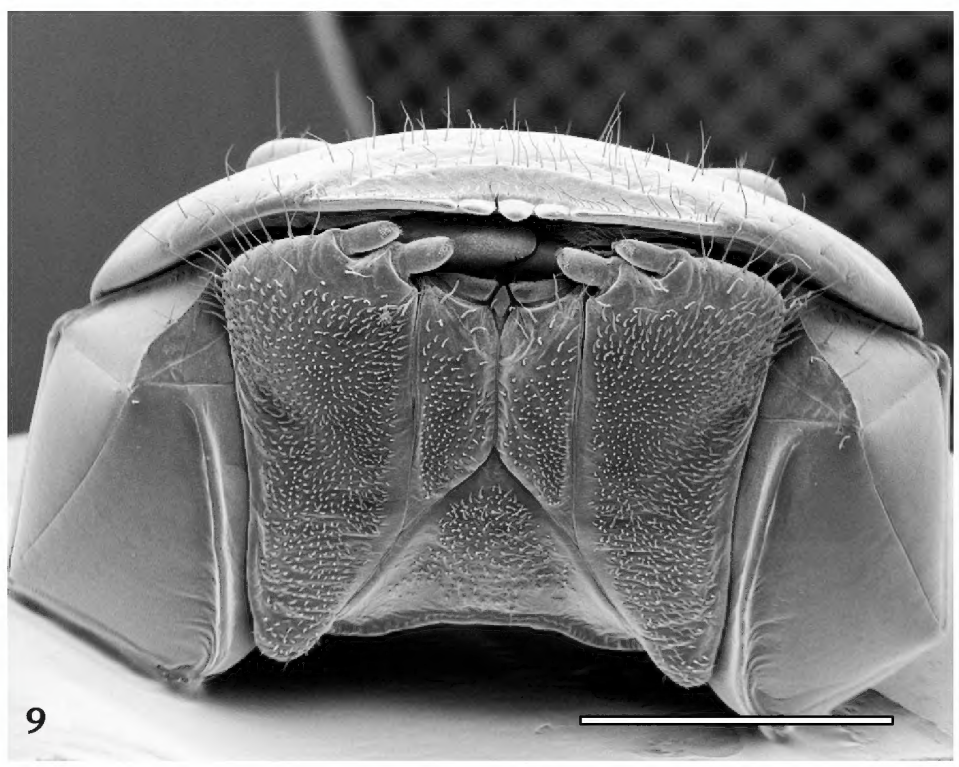
Remarks. The tribe Macrocoxodesmini currently includes two genera: *Macrocoxodesmus* (monotypic) and *Eucampesmella*. According to Hoffman (1990a) the tribe is diagnosed by trichosteles (= granules) on postfemur and tibiae of males, enournously enlarged valves of the vulvae and unusual curvature of the tracheal apodemes of the 2nd legpair in females.

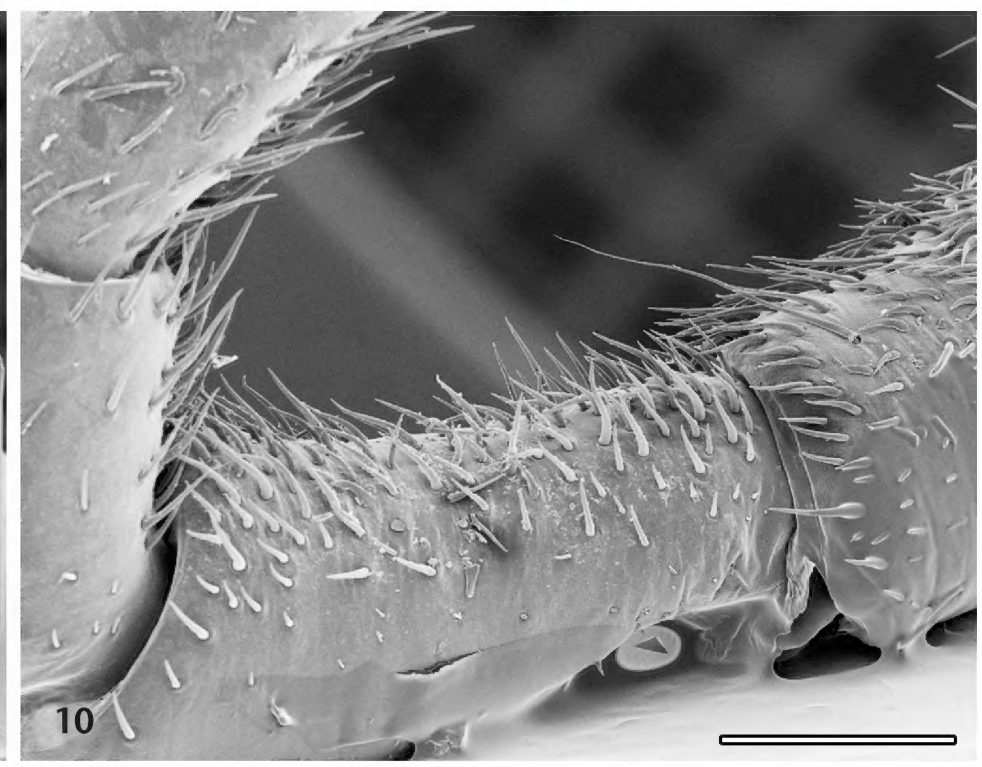




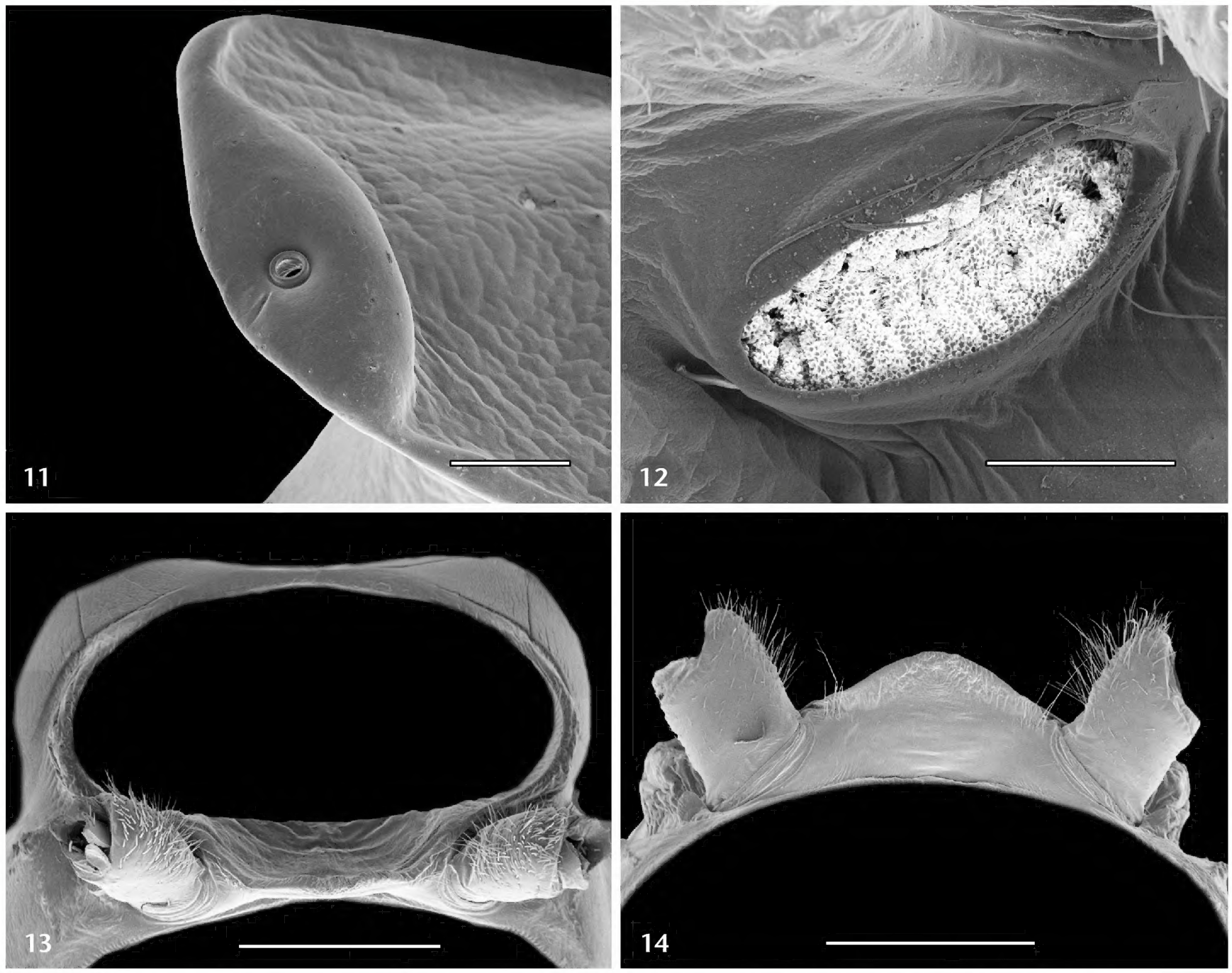








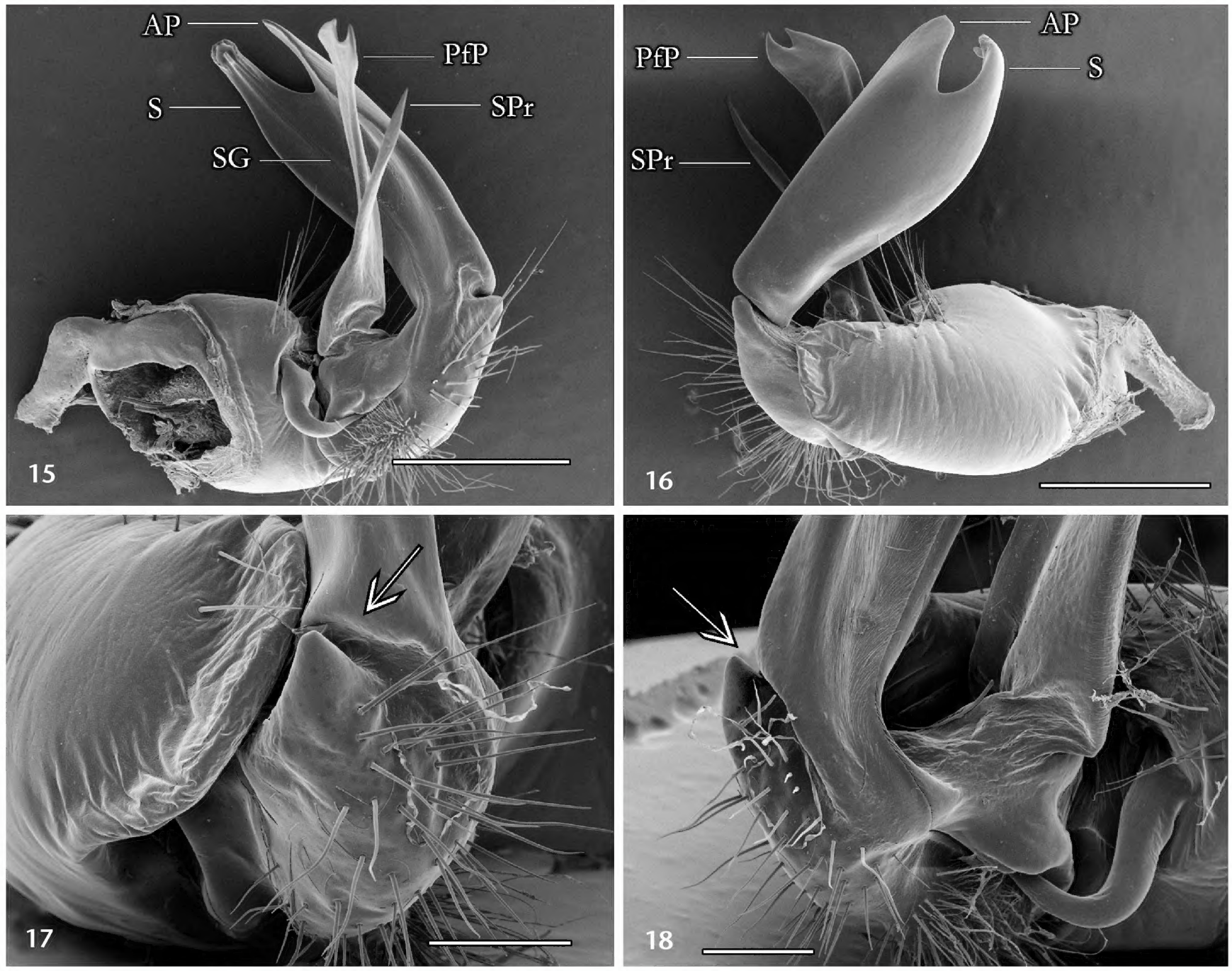
Figures 5–10. Structures of *Eucampesmella*: (5) head; (6) detail of *incisura lateralis*; (7) last antennomere; (8) patches with modified setae near the apical sense cones; (9) Gnathochilarium; (10) midbody leg, ventral detail. Scale bars: 5, 9 = 2 mm, 6–8 = 300 µm, 10 = 500 µm.



Figures 11–14. Structures of *Eucampesmella*: (11) detail of the edge of paranota; (12) detail of stigma; (13) 7th body ring, detail of gonopod aperture, ventral view; (14) 7th body ring, anal view. Scale bars: 11 = 500 µm, 12 = 200 µm; 13, 14 = 2 mm.

Key to males of *Eucampesmella*

1. Secondary process of the prefemoral process in basal position (Fig. 30) 2
1'. Secondary process of the prefemoral process in medial position (Fig. 32) 6
2. Presence of indentations in the distal margin of the acropodital process (Fig. 29) ..... *Eucampesmella tricuspis*
2'. Absence of indentations in the distal margin of the acropodital process 3
3. Secondary process medium-sized, equal or shorter than half of the prefemoral process (Fig. 40) 4
3'. Secondary process as long as prefemoral process (Fig. 37) 5
4. Presence of a median projection on the prefemoral process (Figs 40, 41) ..... *Eucampesmella serrana*
4'. Absence of a median projection on the prefemoral process (Fig 42) ..... *Eucampesmella macunaima* sp. nov.
5. Presence of one acropodital process (Fig. 37) ..... *Eucampesmella expansa*
5'. Presence of two acropodital processes (Figs 30, 31)..... *Eucampesmella sulcata* stat. rev.
6. Solenomere and acropodital process separating in the midlength on the acropodite region (Fig. 62) 7
6'. Solenomere and acropodital process separating apically on the acropodite region (Fig. 55) 8
7. Secondary process of the prefemoral process short (Fig. 61)..... *Eucampesmella lalla* sp. nov.
7'. Secondary process of the prefemoral process long..... *Eucampesmella janetae*
8. Acropodital process spoon-shaped (= rounded), in ventral view (Fig. 54) 9
8'. Acropodital process subtriangular, in ventral view (Fig. 49)..... 10
9. Secondary process of the prefemoral process short and thin (Figs 32, 33) ..... *Eucampesmella lartiguei*
9'. Secondary process of the prefemoral process bigger and thicker (Figs 53, 54)..... *Eucampesmella iracema* sp. nov.
10. Solenomere less wide than the acropodital process (Fig. 58)..... 11
10'. Solenomere wider than the acropodital process (Figs 48, 50)..... *Eucampesmella brascubas* sp. nov.



Figures 15–18. Structures of *Eucampesmella*, left gonopod of *E. macunaima* sp. nov.: (15) mesal view; (16) ectal view; (17) detail of deep separation between the prefemoral region and acropodite region, ventral view; (18) detail of the cannula and deep separation between the prefemoral region and acropodite region, mesal view. Scale bars: 15–16 = 1mm, 17–18 = 500 µm.

11. Secondary process of the prefemoral process short (not reaching the apex of the prefemoral process; Fig 46)..... .....*Eucampesmella capitu* sp. nov.

11'. Secondary process of the prefemoral process long (about reaching the apex of the prefemoral process; Fig 57)..... ..... *Eucampesmella pedrobala* sp. nov.

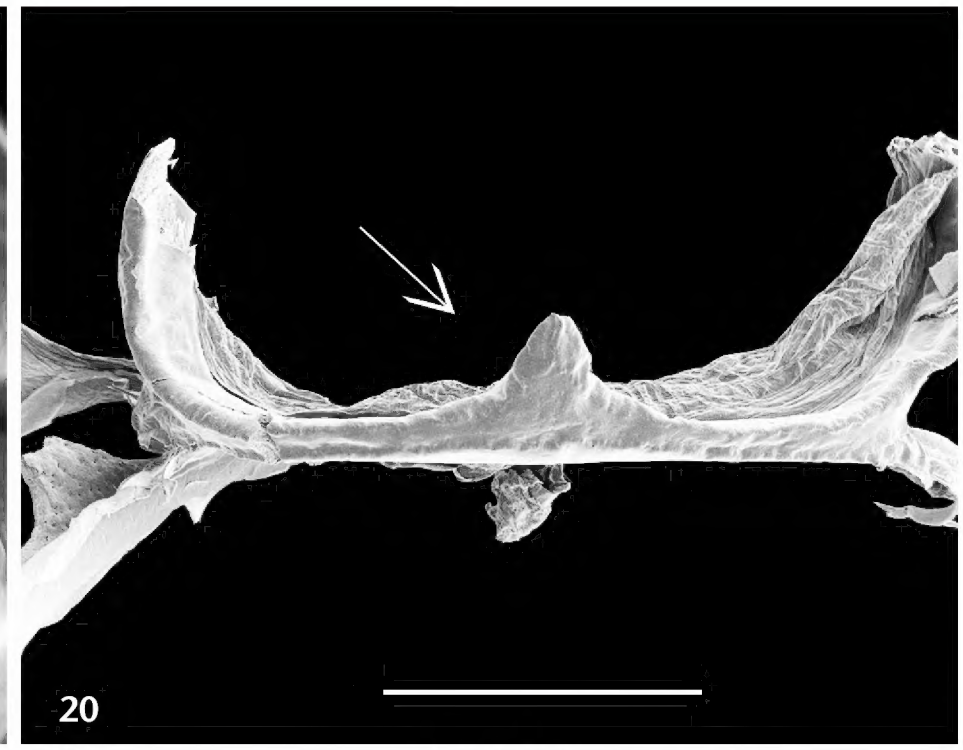
Eucampesmella tricuspis (Attems, 1931)

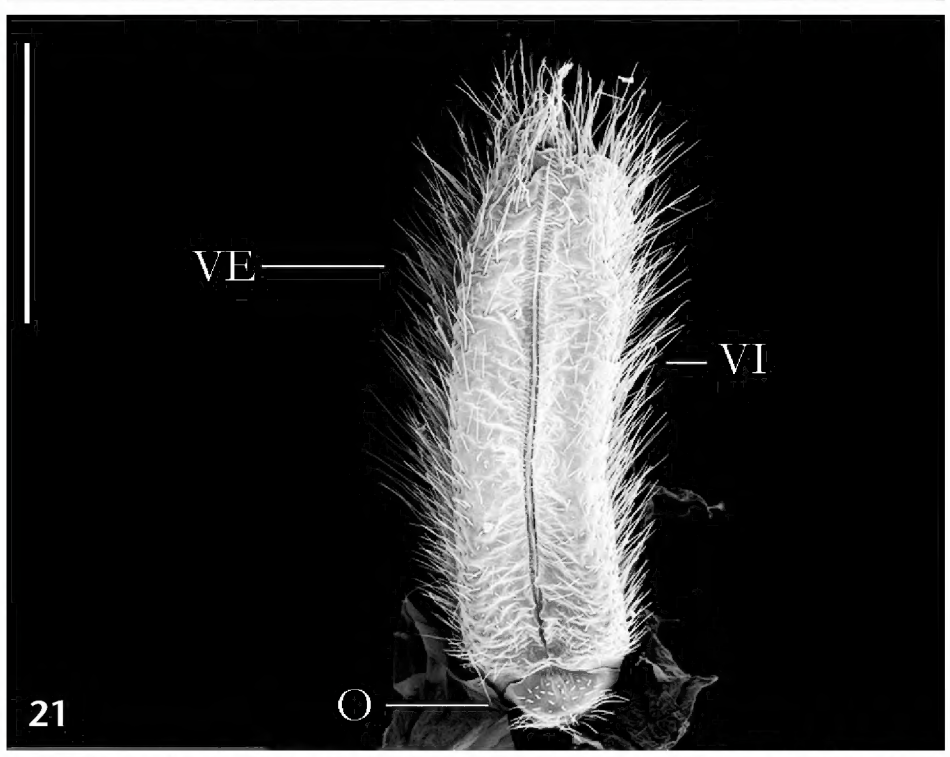
Figs 25–29

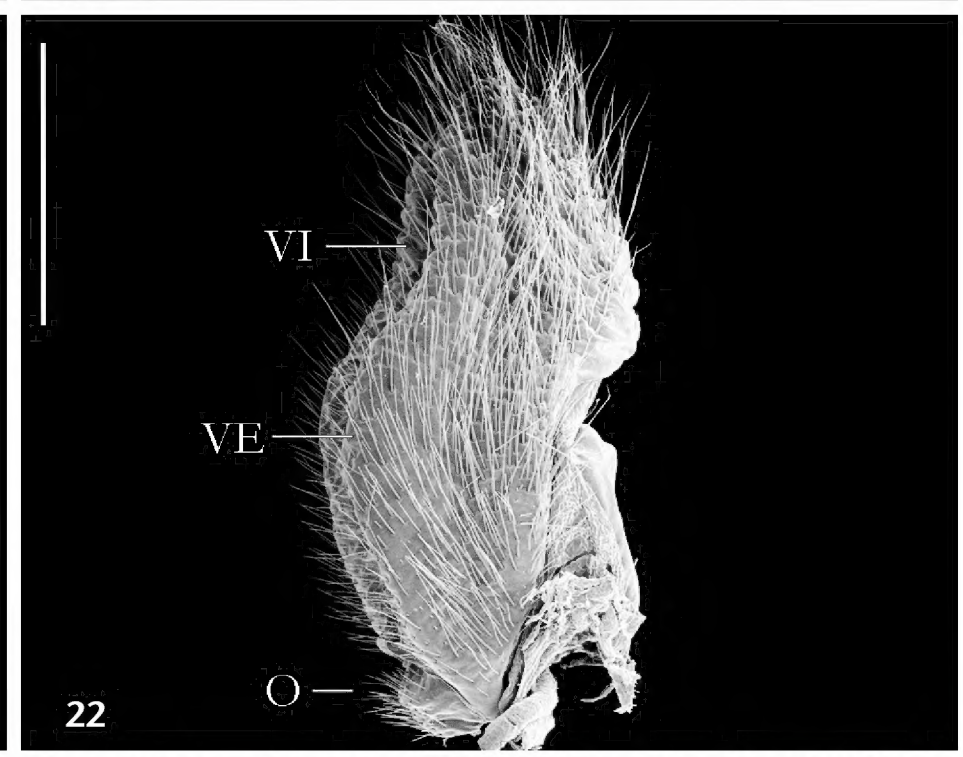
Pseudoleptodesmus (*Pseudoleptodesmus*) *tricuspis* Attems, 1931: 27, fig. 37-39 (Male holotype from Brazil, deposited in NHMW, examined).
Leptodesmus (*Pseudoleptodesmus*) *tricuspis*: Attems, 1938: 41, fig. 44.
Leptodesmus tricuspis: Schubart, 1946: 196.
Pseudoleptodesmus tricuspis: Hoffman, 1953: 124.
Eucampesmella triscuspis: Schubart, 1955: 509.
Eucampesmella tricuspis: Hoffman, 1967: 186; 1990a: 170.

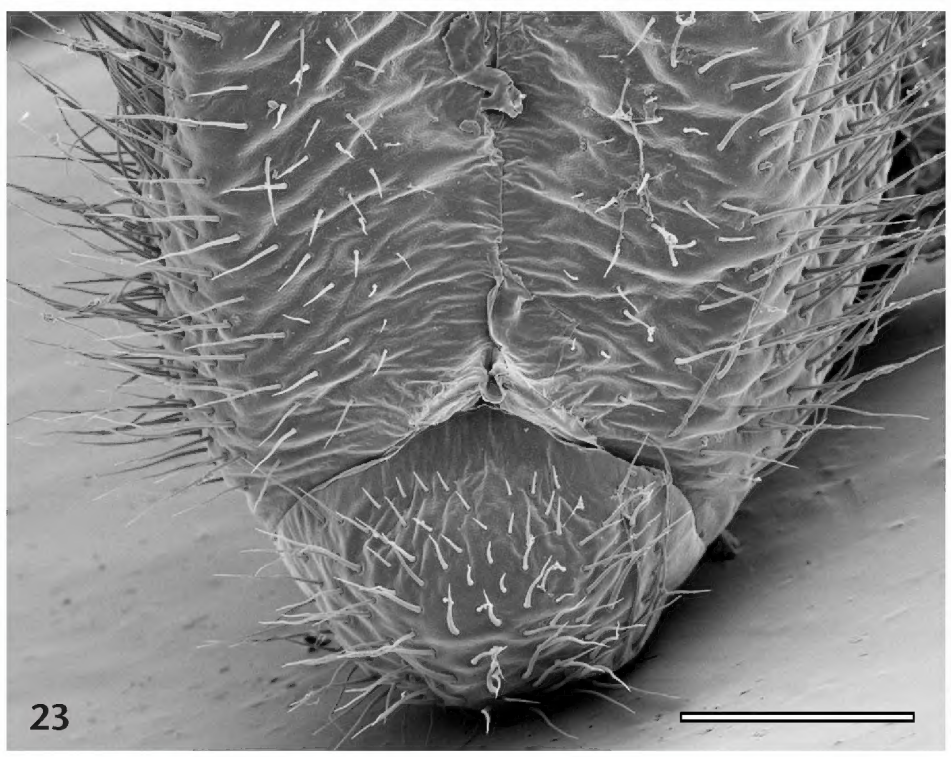
Diagnosis. Males of *Eucampesmella tricuspis* differ from all other species of the genus by the presence of an enlarged spoon-shaped acropodital process with serrated apical margin (Fig. 29); prefemoral process with spear-shaped tip, and small subtriangular projection, curved mesad (Fig. 29).

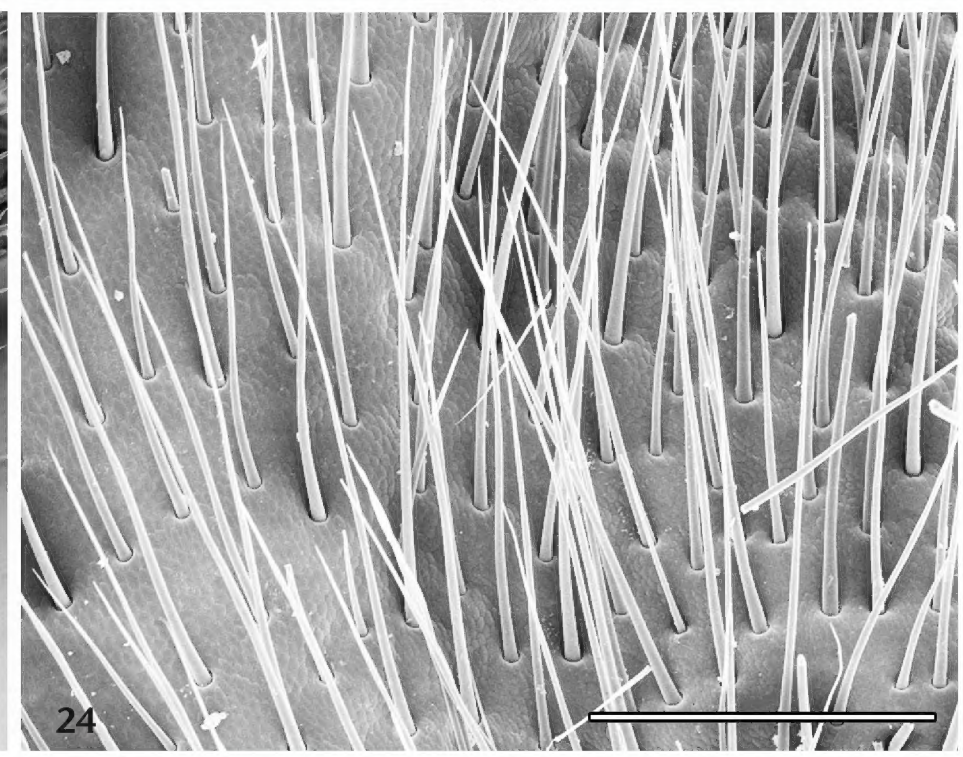
Redescription. Male (Holotype, NHMW). Total length 40, width 6.6. Coloration (long-preserved in 70% ethanol): Head light brown; with three pairs of setae between the antennae (row 0, 1 and 2); clypeus with few random setae. Antennae light brown to brownish. Body brown and paranota tip whitish (Figs 25–27). Body rings: cuticle rough; paranota with posterior edges rounded; ozopore posteriorly situated on paranota. Stigma oval, almost flat. Sternite of body ring 4 with a pair of projections; Sternite of body ring 5 with two pairs of setose projections, the anterior are place together and are more conspicuous, the posterior are placed far apart. Sternite of body ring 6 without projections, but the anterior zone between the coxae has a cluster of setae. Post-gonopodal sternites without setae and with low projections next to each coxae. Gonopod aperture on body ring 7 elliptical, posterior edge with prominent folds; in anal view the posterior



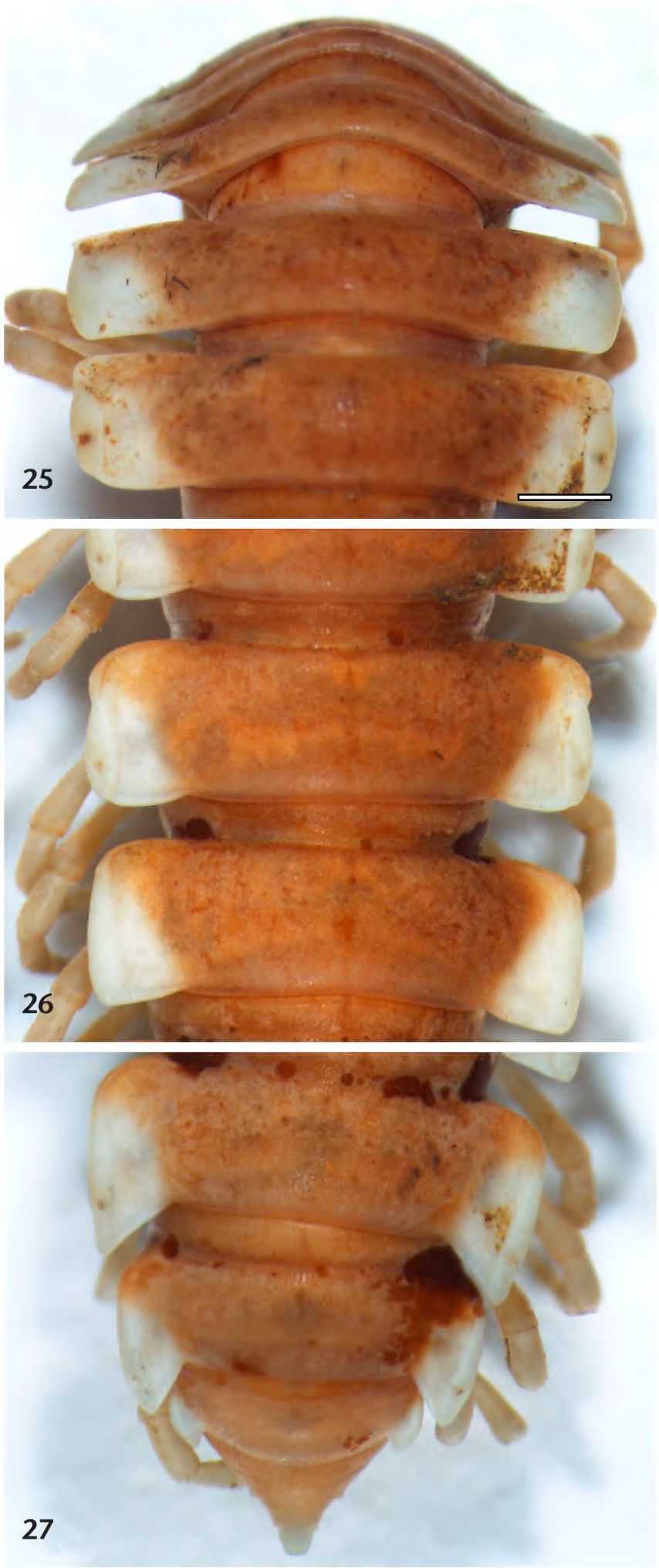


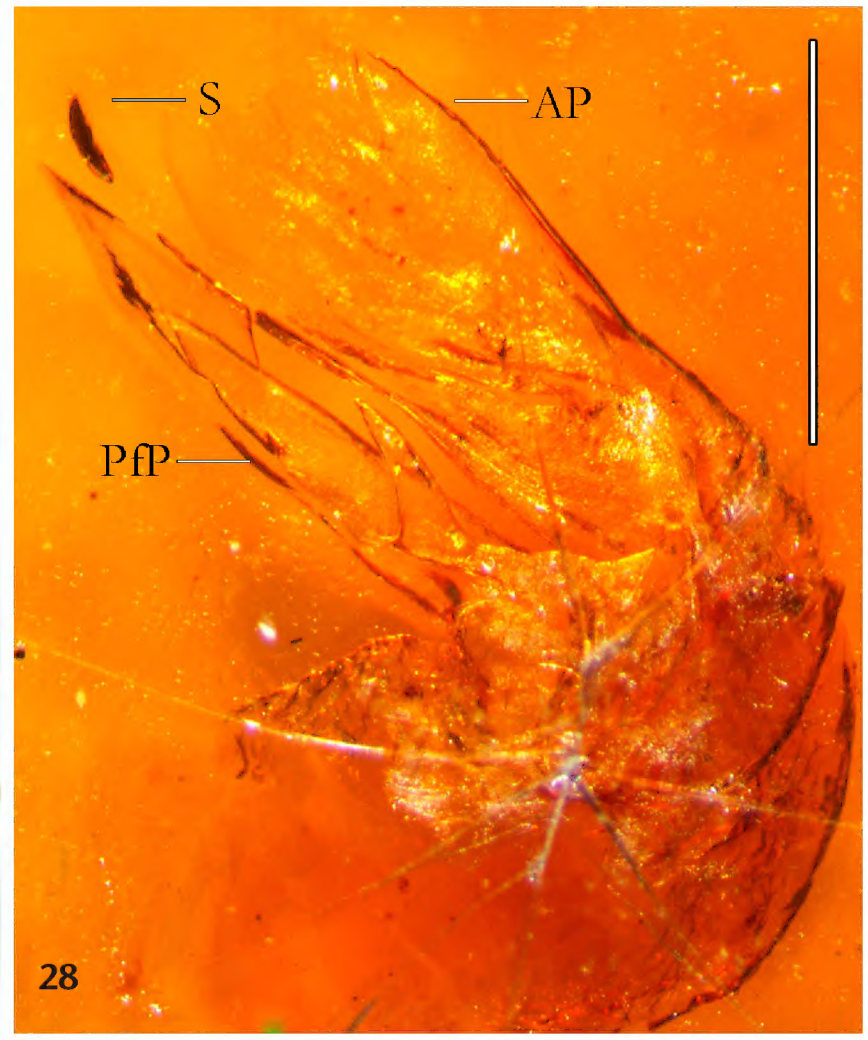


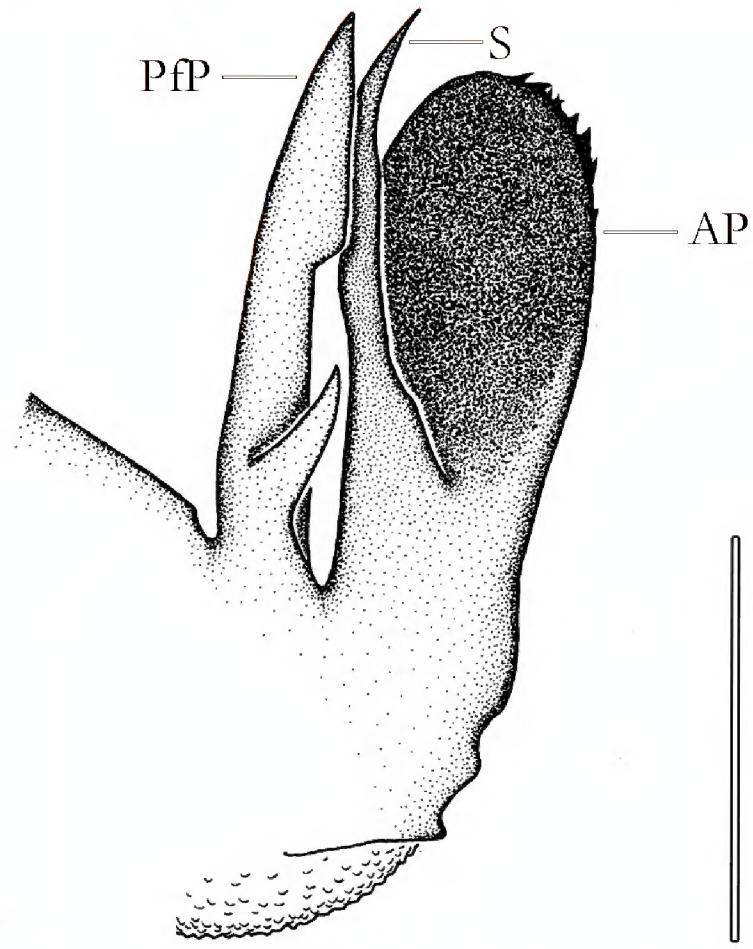




Figures 19–24. Structures of *Eucampesmella*, adult female of *E. macunaima* sp. nov.: (19) 3rd body ring; (20) detail of epigyne; right vulva: (21) ventral view; (22) lateral view; (23) detail of the operculum; (24) detail of the setae on the external valve. Scale bars: 19 = 2 mm; 20–22 = 1 mm; 23 = 400 µm; 24 = 200 µm.







Figures 25–29. *Eucampesmella tricuspis*, holotype, NHMW: (25) dorsal view of anterior; (26) midbody and (27) posterior body rings; (28, 29) left gonopod: (28) microscope slide with gonopod, mesal view; (29) schematic drawing of gonopod, mesal view. Scale bars: 1 mm.

margin is protuberant and rounded. Legs light brown; presence of a pronounced dorsal lobe and a ventro-apical projection on the prefemur of the anterior legs; anterior legs ventrally rather setose; more setae ventrally on the legs; posterior legs ventrally with few very thin setae, coxae and prefemur each with a single long setae. Telson brown with the tip of the posterior margin whitish.

Gonopods (Figs 28, 29): coxae well developed, almost covering the entire prefemoral region, in ectal view. Cannula

broken. Telopodite with the main branch of the prefemoral process and both branches of the acropodite equally long [prefemoral process the same size of the acropodite], slender straight spikes, parallel to each other. Prefemoral process with a second smaller branch, curved mesad (Fig. 29). Acropodital process enlarged, with some indentations in the apical margin (Fig. 29); solenomere long and slender (Fig. 29).

Female. Unknown.

Remarks. The type-material from NHMW is partially in good conditions, with body intact and well-preserved. However, the gonopods slides are broken and further details are impossible to extract (Fig. 28).

Distribution. Brazil, without specific locality.

Eucampesmella sulcata (Attems, 1898), stat. rev.

Figs 30, 31

Cordyloporus sulcatus Attems, 1898: 364 (Male from the state of Bahia, Brazil, deposited in ZMH, not examined [gonopods missing]); Attems, 1938: 379; Weidner, 1960: 82; Hoffman, 1967: 186.

Prepodesmus sulcatus: Chamberlin, 1952: 330

Leptodesmus tuberculiporus Attems, 1898: 384 (Based upon the same type-specimen of *Cordyloporus sulcatus*, see Hoffman, 1967: 185); Brölemann, 1909: 73; Attems, 1938: 42; Schubart, 1948: 87 (synonymized under *Eucampesmella lartiguei*; revalidated by Hoffman, 1967: 186); Weidner, 1974: 114.

Pseudoleptodesmus tuberculiporus: Attems, 1931: 31.

Eucampesmella tuberculipora: Hoffman, 1967: 186 (comments on the synonymy under *L. lartiguei* and revalidation of *E. tuberculipora*).

Diagnosis. Males of *Eucampesmella sulcata* stat. rev. differ from all other species of *Eucampesmella* by the presence of a slender and long solenomere (similar to *E. tricuspis*, but differing by acropodital process being divided into two branches in the apical portion); internal branch of the process of the acropodite subrectangular in shape in ectal view (Fig. 31). The prefemoral process of *E. sulcata* stat. rev. similar to males of *E. expansa* by having elongated and slender secondary process (Fig. 30); but differing from *E. expansa* by absence of rounded projection on the tip of the prefemoral process and also its length (overreaching the acropodite in *E. expansa*).

Additional material examined. BRAZIL: "Soledad?", 1 male, 15.iii.1903, Austrian Brazilian Expedition coll. (NHMW).

Distribution. Known only from Bahia state.

Remarks. The epithet name *tuberculipora* was given priority by Hoffman (1967) over *sulcatus* (for more details, Hoffman 1967: 183-185). However, the prevalence of *tuberculipora* is in disagreement with the reversal of precedence (ICZN, article 23.9.). The supposed junior synonym (in this case, *tuberculipora*) has not been used in at least 25 published works by at least 10 authors (see condition 23.9.1.2.). Based on this, herein we suggest the maintenance of *sulcatus* (in concordance with feminine gender, *Eucampesmella sulcata*).

Eucampesmella lartiguei (Silvestri, 1897), stat. nov.

Figs 32–36, 66

Catharodesmus Lartiguei Silvestri, 1897: 358, figs 45-48. (Male holotype from Pernambuco, Brazil, deposited in ISNB, not examined).

Leptodesmus lartiguei: Attems, 1899: 427; Brölemann, 1909: 70; Schubart, 1948: 87, figs 1-2 (listed as a senior synonym of *Leptodesmus tuberculiporus*, *tuberculiporus* revalidated by Hoffman, 1967: 186).

Leptodesmus lartiguei lartiguei: Schubart, 1956: 424.

Eucampesmella lartiguei lartiguei: Hoffman, 1967: 186.

Leptodesmus lartiguei ferrii Schubart, 1956: 423 (Male holotype from Alto Bonito (near Monumento Natural do Rio São Francisco), 9°46'56"S; 38°01'67"W, Delmiro Gouveia, Alagoas (See Remarks), Brazil, deposited in MZSP, examined). Syn. Nov.

Eucampesmella lartiguei ferrii: Hoffman, 1967: 186.

Eucampesmella ferrii: Pena-Barbosa et al., 2013: 744 (erroneously not cited as subspecies).

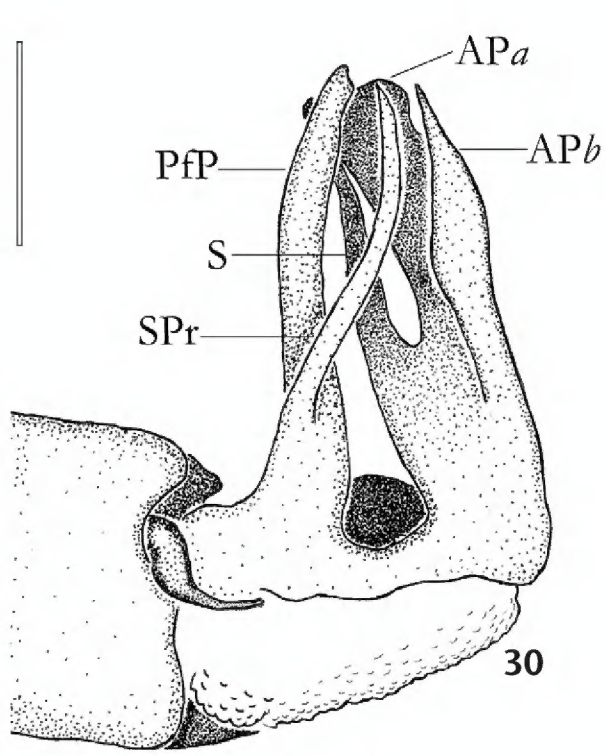
Diagnosis. Males of *Eucampesmella lartiguei* differ from all other species of the genus by having an apical fold on the prefemoral process, in mesal and ventral view; by the short process at the prefemoral process, at the middle and ventrally pointed, in mesal and ventral view (Figs 32, 33). This process is also observed in *E. brascubas* sp. nov., but differing by the size, being longer and pointed anteriorly in *E. brascubas* sp. nov.

Additional material examined. BRAZIL: Rio Grande do Norte: Baia Formosa (6°22'16"S; 35°00'20"W), Mata da Estrela, 1 male, vii.1993, D. Farias coll. (IBSP 1074); Paraíba: João Pessoa, Santa Rita (7°08'03"S; 34°57'59"W), 1 male, xii.2006, W.A. de Moura coll. (IBSP 3038); Pernambuco: Rodovia BR 101 (7°52'56"S; 34°54'20"W), 4 males 1 female, 15.iii.1999, A.B. Kury & A. Giupponi coll. (MNRJ 11609); Recife, Parque Estadual Dois Irmãos, Bairro Apipucos (8°03'59"S; 34°53'56"W), 1 male, 01-03.iii.2012, Sampaio-Costa coll. (IBSP 4429).

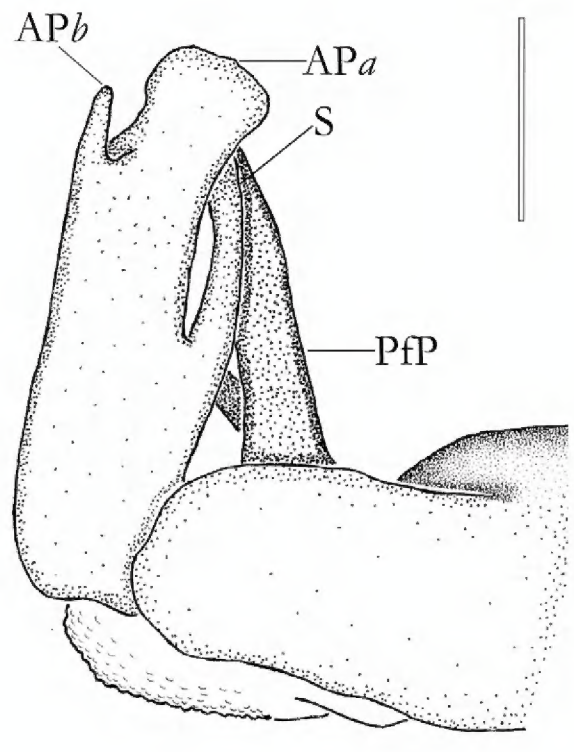
Distribution. Holotype labeled only as "Pernambuco", without exact locality; also known in states of Ceará, Rio Grande do Norte, and Alagoas (Fig. 66).

Justification of synonymy. The original description made by Schubart (1956) for *Leptodesmus lartiguei ferrii* was based on single male (45 mm length, 7.6 mm wide). Schubart also noted that the species agrees with *Leptodesmus lartiguei* (Silvestri, 1897) in all somatic characters. Through the examination of the type material *Eucampesmella l. ferri* and analysis of the original work and drawings of *Eucampesmella l. lartiguei* provided by Silvestri (1897), as well as the accurate exam of several specimens identified by Otto Schubart, we concluded that the males of both nominal species present complete agreement when considering the body shape and the morphology of the gonopod. A slight difference in the form of the acropodital apex is here treated as just an intraspecific variation. Therefore, it is proposed herein *E. lartiguei ferrii* as a junior synonym of *E. lartiguei lartiguei*.

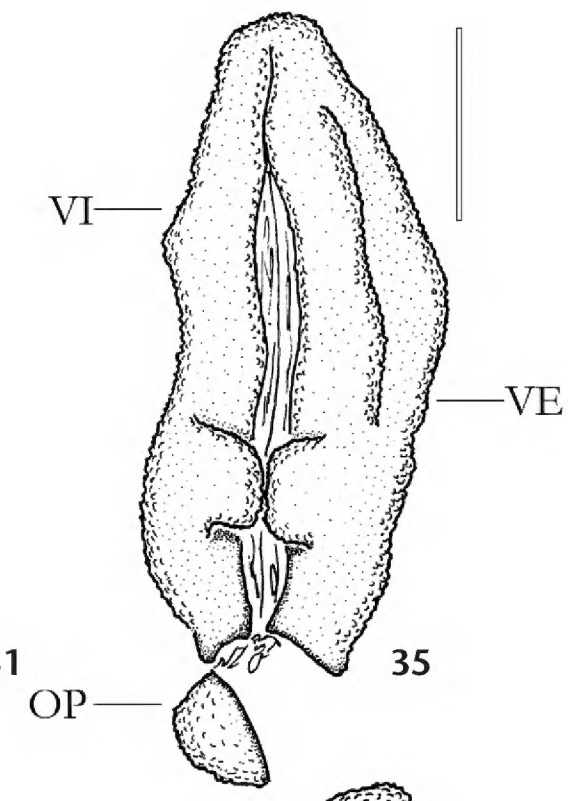
Remarks. The type-locality of *Leptodesmus lartiguei ferrii* was originally cited as Alto Bonito in the South of Cachoeira de Paulo Afonso (Paulo Afonso Falls), municipality of Glória, Bahia state



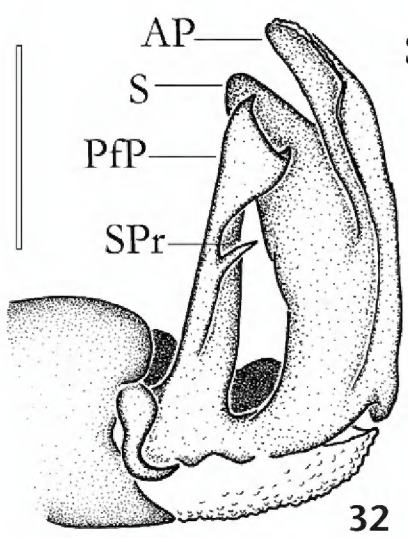
30



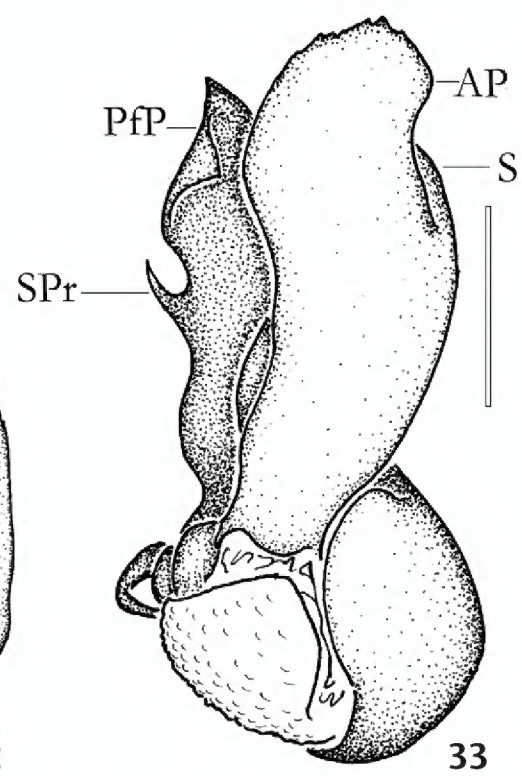
31



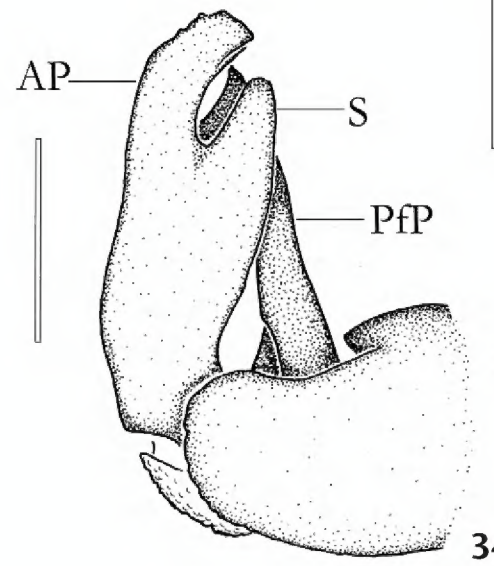
35



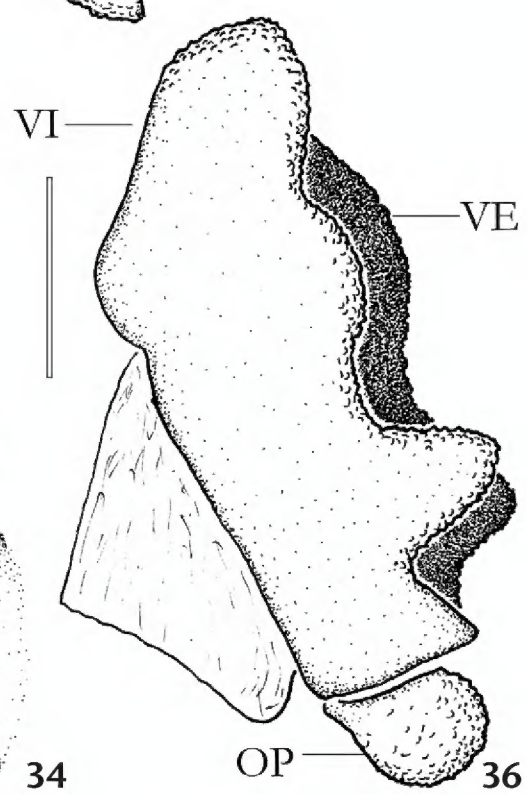
32



33



34



36

Figures 30–36. (30–31) *Eucampesmella sulcata* stat. rev., NHMW, left gonopod: (30) mesal view; (31) ectal view. (32–34) *Eucampesmella lartiguei* stat. nov., IBSP 4429, left gonopod: (32) mesal view; (33) ventral view; (34) ectal view. (35–36) *Eucampesmella lartiguei* stat. nov., MNRJ 11609, left vulva: (35) ventral view; (36) lateral view. Scale bars: 30–34 = 1 mm, 35–36 = 500 µm.

(Schubart 1956: 423). After checking local gazetteers, we found that Alto Bonito refers to an area belonging to the municipality of Delmiro Gouveia, Alagoas, and not in Bahia, as referred in the original description. It is important to note that Paulo Afonso Falls is located in Paulo Afonso, currently a municipality in Bahia. This region is located at the border of the states of Bahia and Alagoas, surrounding by the Paulo Afonso Hydroelectric Complex, a system of dams and power plants on the São Francisco River.

Eucampesmella expansa (Brölemann, 1903)

Figs 37–39, 66

Leptodesmus expansus Brölemann, 1903: 672, figs 23, 24. (Female holotype labeled only as from "Sertão de Pernambuco", Brazil, deposited in MNHN, not examined). Brölemann, 1909: 67; Attems, 1938: 49; Schubart, 1948: 90, figs 3, 4 (Description of male from Boa Vista, Orocó, 8°30'54"S; 39°34'32"W, Pernambuco, Brazil, 7.xii.1937. O. Schubart coll., deposited in MZSP, examined).

Eucampesmella expansa: Hoffman, 1967: 186.

Diagnosis. Males of *Eucampesmella expansa* differ from all other species of the genus by having the prefemoral process divided into two narrow branches of equal length (Figs 37–39).

Additional material examined. BRAZIL: Bahia: Andaraí (12°39'31"S; 41°12'11"W), 1 male, 09-19.xii.2010, R.S. Recoder coll. (IBSP 4389).

Distribution. Only known for states of Pernambuco and Bahia (Fig. 66).

Eucampesmella serrana (Attems, 1944)

Figs 40, 41, 66

Leptodesmus (Pseudoleptodesmus) serranus Attems, 1944: 277 (Male holotype from Juazeiro, 9°25'23"S; 40°30'28"W, Bahia, Brazil, Austrian Brazilian Expedition 1903-05 col., deposited in NHMW, examined).

Eucampesmella serrana: Hoffman, 1967: 186.

Diagnosis. Males of *Eucampesmella serrana* differ from all other species of the genus by the basal branch in prefemoral process reaching half the size of the process (Figs 40, 41); presence of small second branch on prefemoral process (Figs 40, 41).

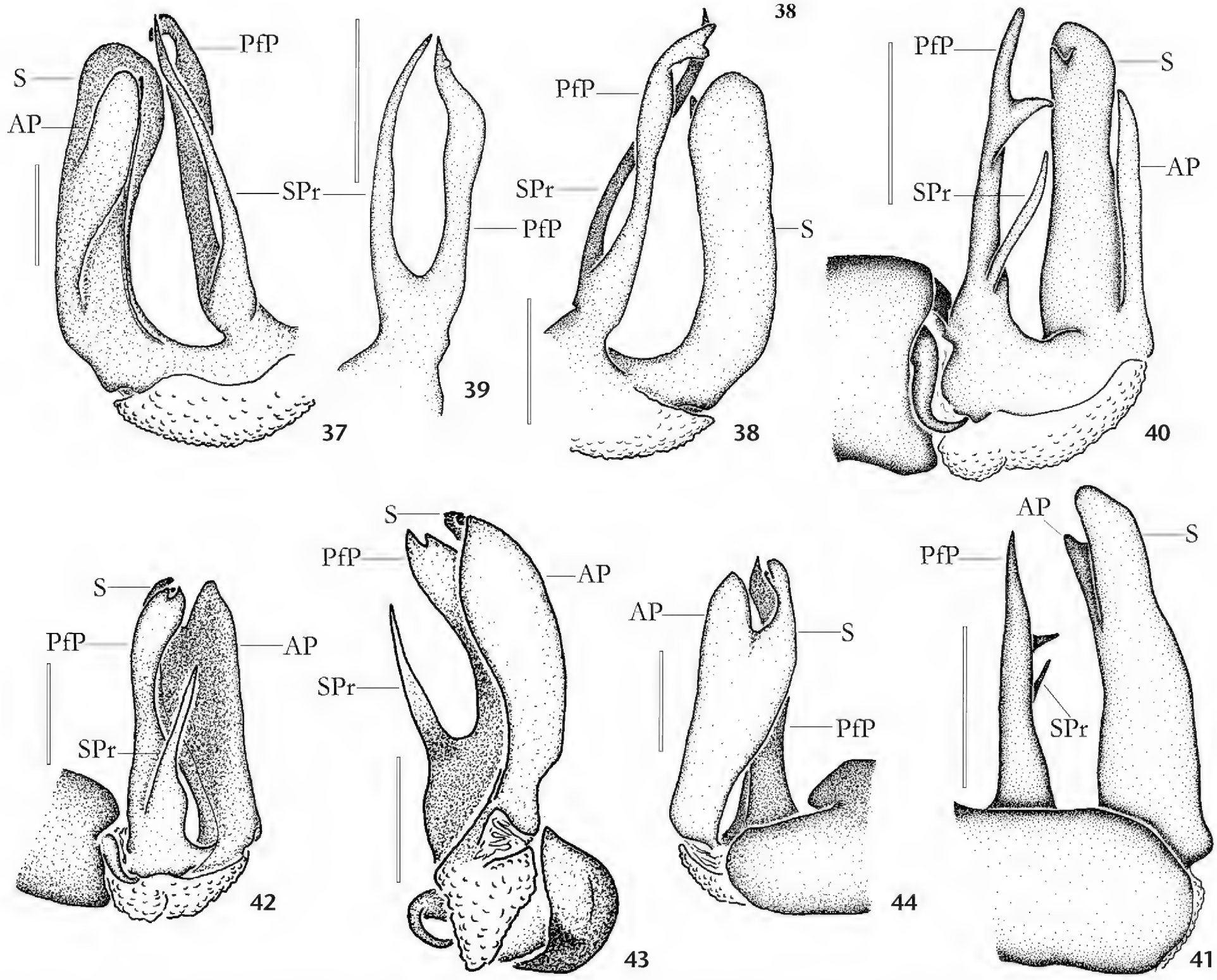
Distribution. Only known for the type-locality (Fig. 66).

Eucampesmella janetae Golovatch & Hoffman, 2004

Fig. 66

Eucampesmella janetae Golovatch and Hoffman, 2004: 52, figs 6-13 (Male holotype from Macapá, 0°02'26"S; 51°04'17"W, Amapá, Brazil. 14.ii.2000. E.L. Oliveira coll., deposited in IEPA, not examined; female paratype, IEPA; male paratype, ZMUM; male paratype, MHNG; male paratype, VMNH; female paratype, MZSP, same data as holotype, not examined).

Diagnosis. Males of *Eucampesmella janetae* differ from all other species of the genus by having the terminal telopodite structures (prefemoral process and acropodite) divided into two branches in the middle of both processes, which results in four branches of almost equal length.



Figures 37–44. (37–39) *Eucampesmella expansa*, MZSP, right gonopod: (37) mesal view; (38) ectal view; (39) detail of the prefemoral process, ventral view. (40–41) *Eucampesmella serrana*, holotype, NHMW, left gonopod: (40) mesal view; (41) ectal view. (42–44) *Eucampesmella macunaima* sp. nov., holotype, IBSP 3632, left gonopod: (42) mesal view; (43) ventral view; (44) ectal view. Scale bars: 37–41 = 1 mm, 42–44 = 600 µm.

Additional material examined. BRAZIL: Ceará: Maranguape (3°52'54"S; 38°40'39"W), 1 male, i.1964, A.L. Castro coll. (MNRJ 11626).

Distribution. Known from states of Amapá and Ceará (Fig. 66).

Remarks. A recent, complete and well-detailed description is available in Golovatch and Hoffman (2004).

Eucampesmella macunaima sp. nov.

Figs 1–4, 15–24, 42–44, 67

http://zoobank.org/B2066EEE-A670-47FB-9AD9-EC8C52705402

Diagnosis. Males of *Eucampesmella macunaima* sp. nov. differ from all other species of the genus by the presence of an acute basal branch in prefemoral process (Fig. 42), similar to *E. serrana* but without any other projection in the apical portion.

Type material. Holotype: Male from Belém (01°27'21"S; 48°30'14"W), Pará, Brazil, 12-15.ii.2009, A.D. Brescovit coll. (IBSP 3632). Paratypes: one female with same data as for holotype (IBSP 3633); one male and one female from Museu Paraense Emílio Goeldi, Campus de Pesquisa, Belém, 13.i.2011, E.G. Cafofo coll. (MPEG 48); one male and one female from Residencial Jardim Universitário, Belém, 22-31.viii.2016, A.D. Brescovit coll. (MZSP 1159 and MZSP 1160, respectively).

Description. Male (Holotype, IBSP 3632). Coloration (long-preserved in 70% ethanol): Head brown. Antennae brownish. Body brown and paranota tip yellowish. Body rings: cuticle rough; paranota rounded; ozopore central-posteriorly situated on paranota; peritremata slightly pronounced on the paranota. Stigma oval. Sternite of body ring 4 with one pair of projections; Sternite of body ring 5 with one pair of projections (the former); post-gonopodal sternites with two pairs of triangular projections; Sternite until body ring 9 with the anterior zone between the coxae showing a cluster of setae. Pair of legs on body ring 3 with coxae possessing a rectangular-shaped genital papilla. Gonopod aperture on body ring 7 elliptical, posterior edge with prominent folds, in anal view the posterior margin is projecting and rounded. Legs brownish, with a dorsal lobe on the prefemur. Telson brown with the posterior margin whitish.

Total length: 52.03. Width total: 6.96. Collum, long, 2.32, width, 6.66. Antennomere lengths (1>7): 0.66; 1.43; 1.31; 1.31; 1.39; 1.36; 0.33. Podomeres lengths (1>7): 0.72; 1.03; 1.87; 0.93; 0.92; 1.42; 0.45. Gonopod aperture, long 1.72, width 2.70. Telson, long 1.32. Gonopod: long 2.82, width 2.44. Coxae: long 1.10, width 1.76. Telopodite: long 2.74, width 1.02.

Gonopods (Figs 42–44): coxae equivalent to about half the length of the telopodite and prominent rectangular in ectal view (Fig. 44). Coxae with a row of macrosetae on the dorsal side. Cannula: hook-shaped. Prefemoral region ventrally developed, about 1/3 length of telopodite; ending in a well-demarcated transition zone (Fig. 44). Prefemoral process long and slender; apex slightly broad divided into two small acute tips; a thin secondary process arises in the medial-basal portion, not surpassing the length of the prefemoral process (PfP; Figs 42, 43). Acropodite elongated, robust and broad; apical portion divided into two large branches: the internal one (=solenomere) conducting the prostatic groove that opens on a small sharp projection in the apex of this branch (S; Figs 42, 44). Acropodital process (AP) covering the solenomere (S) in ventral view, spoon shaped (Fig. 43).

Female (Paratype, IBSP 3633). Coloration as in male. Posterior margin of vulvae opening presenting a large triangular-shaped epigyne (Fig. 20). Vulvae (Fig. 21) elongated and slender. Total length: 56.54. Width total: 7.76. Posterior margin of the vulvae aperture: 3, 04 width. Vulvae: long 2.45, width 0.72. External valve: long 2.03, width 0.33. Internal valve: long 1.94, width 0.29. Operculum: long 0.37, width 0.45. Lateral margin of the both valves with long setae and densely setose, central setae short and scattered (Figs 21, 22). Operculum small (OP, Figs 21–23).

Additional material examined. BRAZIL: Pará: Belém (1°26'59"S; 48°29'23"W), Campus MPEG, 1 male, 2010, G. Ruiz coll. (IBSP 4390); Residencial Jardim Universitário, 7 males 7 females, 22-31.viii.2016, A.D. Brescovit coll. (IBSP 12868); 10 males 8 females (IBSP 12869); Museu Paraense Emílio Goeldi, Campus de Pesquisa, 2 males, 9.i.2011, E.G. Cafofo coll. (MPEG 50); 1 female, 6.i.2011, E.G. Cafofo coll. (MPEG 49); 2 females (MPEG 56); 1 male (MPEG 55); 1 male, 4.i.2011, E.G. Cafofo coll. (MPEG 53); 1 male (MPEG 54); 1 female, 7.i.2011, E.G. Cafofo coll. (MPEG 51); 1 male 2 females, 5.i.2011, E.G. Cafofo coll. (MPEG 52); 1 male 1 female, 18.v.2012, D. Candiani coll. (MPEG 132); Rondônia: Porto Velho, Abunã (9°41'41"S; 65°21'24"W), 1 male, 04.ix.2010, Equipe Jirau 3 coll. (IBSP 4385); Piauí: Teresina (5°05'05"S; 42°48'21"W), Mata Secundária de Babaçu, 2 males 2 females 1 immature, 12.ii.2012, I.L.F. Magalhães coll. (IBSP 4527); 1 male (IBSP 4524); 1 male (IBSP 4523); 2 male 4 females (IBSP 4525); 5 males 1 female (IBSP 4526); 1 male 2 females 1 immature (IBSP 4528).

Distribution. Known from Brazilian states of Rondônia, Pará and Piauí (Fig. 67).

Etymology. The species epithet is a reference to the Brazilian literature character "Macunaíma" from the book "Macunaíma: O herói sem nenhum caráter" written by Mário de Andrade. Noun in apposition.

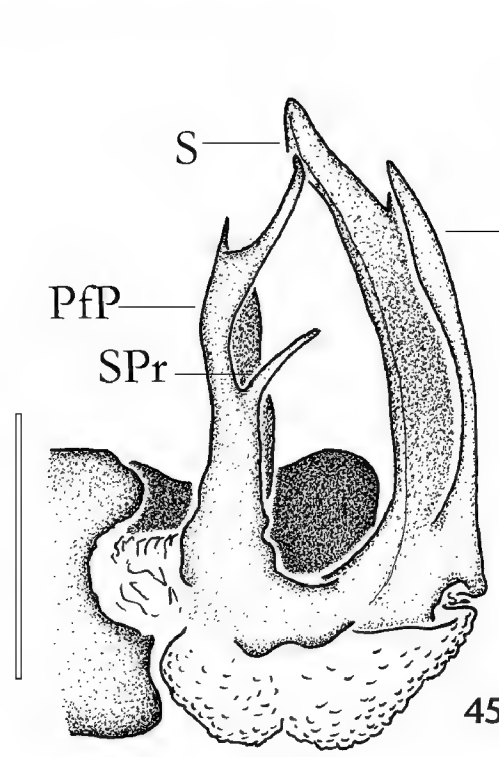
Eucampesmella capitu sp. nov.

Figs 45–47, 67

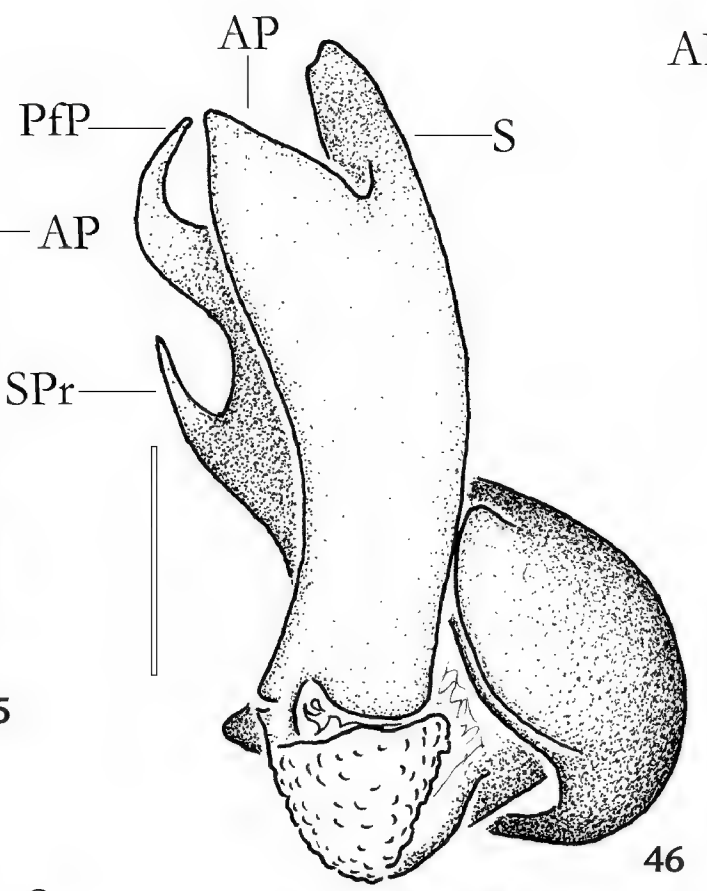
http://zoobank.org/62C71EE1-52A3-44AD-BA05-FB3FA88800E9

Diagnosis. Males of *Eucampesmella capitu* sp. nov. differ from all other species of the genus by the apical portion of prefemoral process divided (Figs 45, 47), similar to *E. pedrobala* sp. nov., but with anterior branch longer than the posterior, while in *E. pedrobala* sp. nov. the two branches have the same length (Fig. 45).

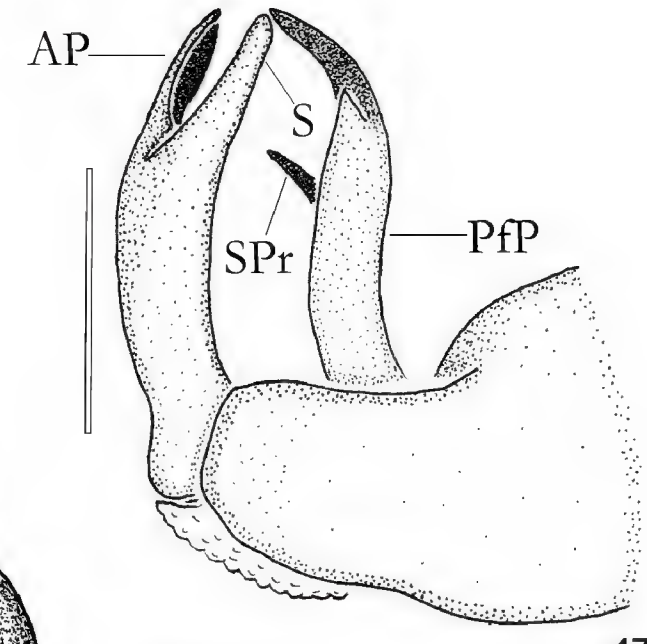
Type material. Holotype: Male from Paraíba, Brazil, 1999, A. Giupponi & A.B. Kury coll. (MNRJ 11959). Paratypes: One male with same data as for holotype (MNRJ 30172).



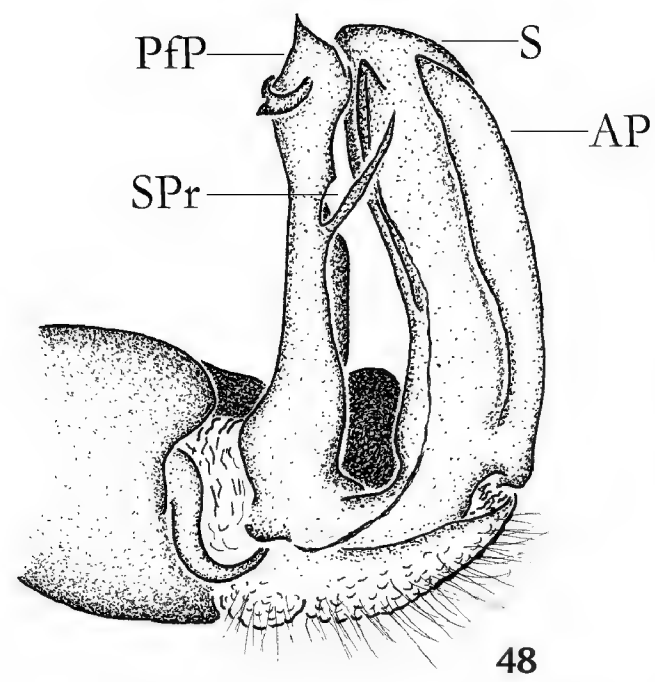
45



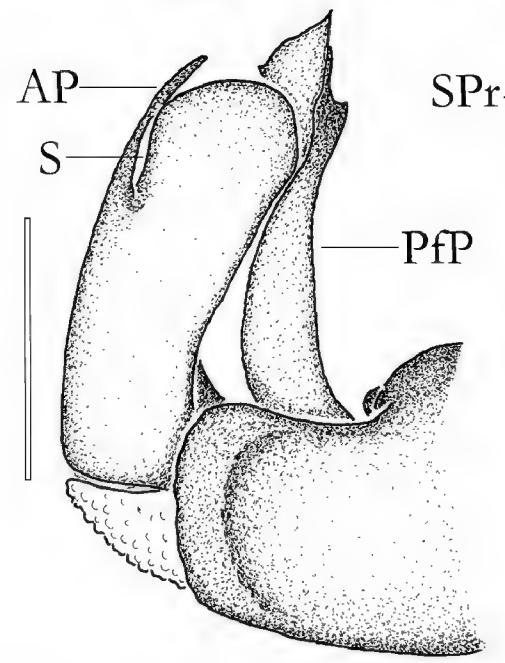
46



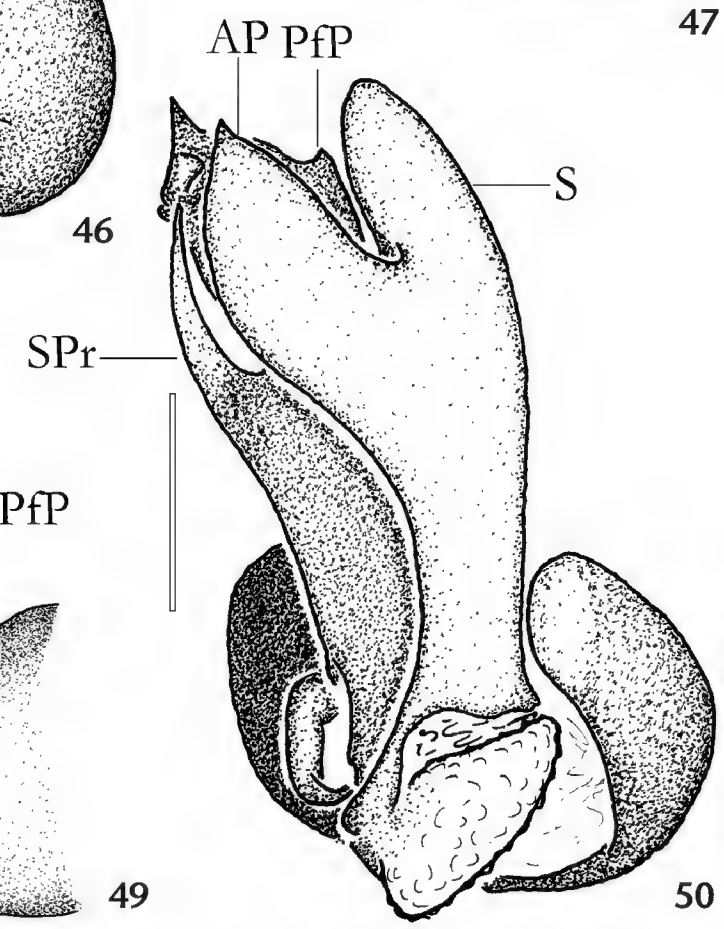
47



48



49



50

Figures 45–50. (45–47) *Eucampesmella capitu* sp. nov., holotype, MNRJ 11959, left gonopod: (45) mesal view; (46) ventral view; (47) ectal view. (48–50) *Eucampesmella brascubas* sp. nov., holotype, MZSP, left gonopod: (48) mesal view; (49) ventral view; (50) ectal view. Scale bars: 800 µm.

Description. Male (Holotype, MNRJ 11959). Coloration (long-preserved in 70% ethanol): Head brownish. Antennae white yellow. Body brown and paranota tip whitish. Legs brownish. Body rings: cuticle rough, with a pattern of slightly raised squares; paranota with posterior edges rounded; ozopore posteriorly situated on paranota. Stigma oval. Sternite of body ring 4 with one pair of projections; Sternite of body ring 5 with two pairs of projections, the former ones are rectangular and the latter ones are triangular; Sternite of body ring 6 with an anterior pair of triangular projections. Pair of legs on body ring 3 with coxae possessing a rectangular-shaped genital papilla, and pairs of legs on body rings 5 to 17 with two pairs of slightly triangular projections between coxae. Gonopod aperture on body ring 7 elliptical, posterior edge with prominent folds, in anal view the posterior margin without any projection. Legs brownish, with a dorsal lobe in the prefemur. Telson brown with the posterior margin whitish.

Total length: 43.51. Width total: 6.75. Antennomere lengths (1>7): 0.51; 1.13; 1.29; 1.32; 1.18; 0.26. Podomeres lengths (1>7): 0.69; 0.93; 1.99; 0.84; 0.91; 1.23; 0.46. Gonopod aperture, long 1.67, width 2.65. Telson, long 1.15. Gonopod: long 2.15, width 2.22. Coxae: long 0.99, width 1.91. Telopodite: long 2.04, width 1.09.

Gonopods (Figs 45–47): coxae equivalent to about the length of the telopodite and prominent digitiform (= rectangular, with rounded corners) in ectal view (Fig. 47). Coxae with a row of macrosetae on the dorsal side. Cannula: hook-shaped. Prefemoral region ventrally developed, about 1/3 length of telopodite;

ending in a well-demarcated transition zone. Prefemoral process long; broad, in dorsal view, except for the terminal branch; a thin and small secondary process arises in the medial portion (PfP; Figs 45, 46). Acropodite elongated, robust and broad; apical portion divided into two large branches: solenomere conducting the prostatic groove that opens on a small sharp projection in the apex of this branch (S; Fig. 47). Acropodital process (AP) subtriangular shaped in ventral view (Fig. 46).

Female. Unknown.

Additional material examined. BRAZIL: Piauí: Serra da Capivara (8°46'39"S; 42°37'03"W), 1 male, 10.ii-03.iii.2013, R.S. Recoder coll. (IBSP 3750).

Distribution. Known from states of Piauí and Paraíba (Fig. 67).

Etymology. The species epithet is a reference to the Brazilian literature character "Capitu" from the book "Dom Casmurro" written by Machado de Assis. Noun in apposition.

Eucampesmella brascubas sp. nov.

Figs 48–52, 67

http://zoobank.org/F8E2AE5F-D7EE-46C1-A107-5C175F4ECD22

Diagnosis. Males of *Eucampesmella brascubas* sp. nov. differ from all other species of the genus by the apical portion of the prefemoral process with a small lateral process near the acuminate apex (Fig. 48). Acropodite with apical portion similar to *E. macunaima* sp. nov., but with solenomere broader (Fig. 48).

Type material. Holotype: Male from Areia Branca (10°45'29"S; 37°18'45"W), Sergipe, Brazil, 22-24.V.1973, Museum of Zoology of São Paulo expedition coll. (MZSP 1155). Paratypes: one male with the same data as for holotype (IBSP 3634); one female with the same data as for holotype (IBSP 3635); one male with the same data as for holotype (MZSP 1156); one female with the same data as for holotype (MZSP 1157); one female with the same data as for holotype (MZSP 1158).

Description. Male (Holotype, MZSP 1155). Coloration (long-preserved in 70% ethanol): Head light brown. Antennae brownish. Body light brown and paranota tip slightly yellowish. Legs brownish. Body rings: cuticle rough, forming a pattern of smooth square shapes; paranota with posterior edges rounded; ozopore central-posteriorly situated on paranota. Stigma oval. Sternite of body ring 4 with one pair of projections; Sternite of body ring 5 with two pairs of projections, the former ones are digitiform and bigger, and the latter ones are smaller and triangular; Sternite of body ring 6 without projections; Sternite of body ring 8 with two pairs of rounded projections. Pair of legs on body ring 3 with coxae possessing a rectangular-shaped genital papilla. Gonopod aperture on body ring 7 elliptical, posterior edge with prominent folds, in anal view the posterior margin has a rounded projecting edge. Legs brownish, with a dorsal lobe on the prefemur. Telson brown with the posterior margin slightly yellowish.

Total length: 51.25. Width total: 7.13. Antennomere lengths (1>7): 0.5; 1.45; 1.45; 1.33; 1.3; 1.15; 0.38. Podomeres lengths (1>7): 0.78; 1.3; 2.13; 0.95; 1.0; 1.4; 0.4. Gonopod aperture, long 2.28, width 3.2. Telson, long 1.25. Gonopod: long 3.0, width 2.83. Coxae: long 1.58, width 2.18. Telopodite: long 2.85, width 1.5.

Gonopods (Figs 48–50): coxae equivalent to about the length of the telopodite and prominent digitiform (= rectangular, with rounded corners) in ectal view (Fig. 50). Coxae with a row of macrosetae on the dorsal side. Cannula: hook-shaped. Prefemoral region ventrally developed, about 1/3 length of telopodite; ending in a well-demarcated transition zone. Prefemoral process long; broad, in dorsal view, except for the terminal part; with two terminal branches, the proximal one broad and leaf shaped and the apical one slightly curved and slender; a slender secondary process arises in the medial portion (PfP; Figs 48, 49). Acropodite elongated, robust and broad; apical portion divided into two large branches: spoon-shaped solenomere conducting the prostatic groove that opens on small projected sharp, clearly demarcated from the middle portion of the branch and terminating just near the apex. (S; Fig. 48). Acropodital process (AP) triangular shaped in ventral view (Fig. 49).

Female (paratype, IBSP 3635). Coloration as in male. Posterior margin of vulvae opening with a small rounded epigyne. Vulvae (Figs 51, 52) elongated and slender. Total length: 53.88. Width total: 7.5. Posterior margin of the vulvae aperture: 2.6 width. Vulvae: long 2.63, width 0.85. External valve: long 2.38, width 0.35. Internal valve: long 2.37, width 0.37. Operculum: long 0.3, width 0.53. Lateral margin of the both valves with long setae and densely setose, central setae short and scattered; external valve and internal valve with a triangular pair of prominences in the zone where the valves are close, in the medial portion (Fig. 52); Operculum small (OP, Figs 51, 52).

Distribution. Only known for the type locality (Fig. 67).

Etymology. The species epithet is a reference to the Brazilian literature character "Brás Cubas" from the book "Memórias Póstumas de Brás Cubas" written by Machado de Assis. Noun in apposition.

Eucampesmella iracema sp. nov.

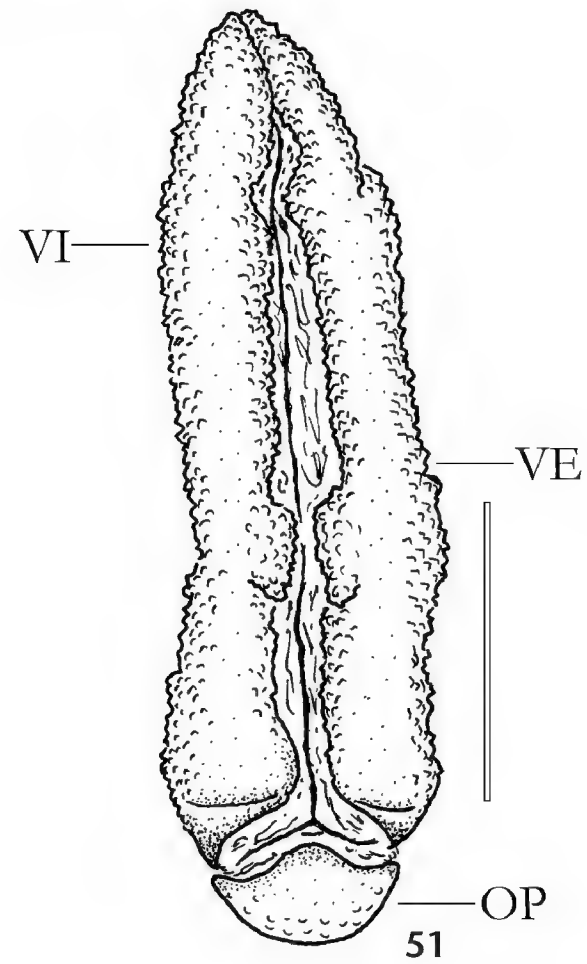
Figs 53–55, 67

http://zoobank.org/C14DDFAD-CFC5-47CE-A54C-9399CDDE373A

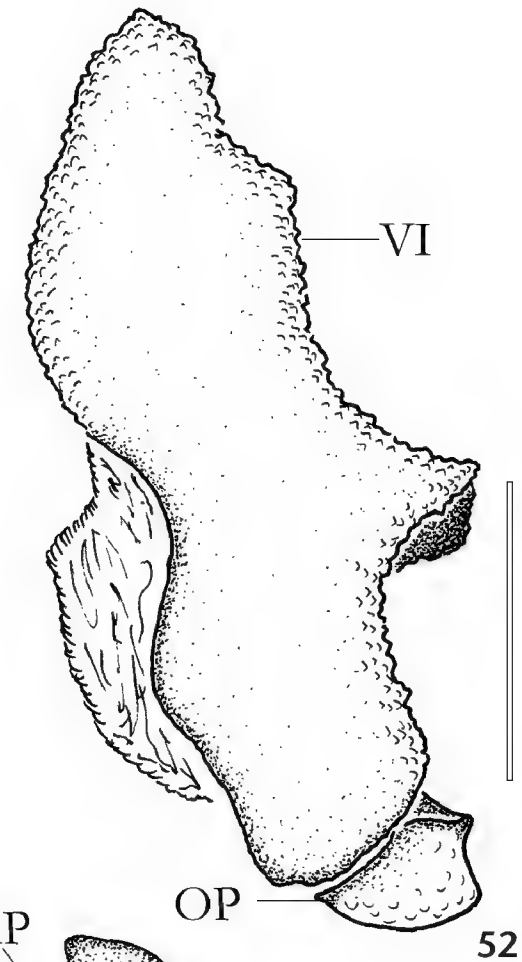
Diagnosis. Males of *Eucampesmella iracema* sp. nov. differ from all other species of the genus by the prefemoral process containing two robust branches, one located on anterior position, other positioned apically (Fig. 53). Acropodite broad, apically divided into two small but robust branches (S and AP; Figs 53, 55).

Type material. Holotype: Male from Serra dos Cavalos (8°21'21"S; 36°01'46"W), Caruaru, Pernambuco, Brazil, 1999, A. Giupponi & A.B. Kury coll. (MNRJ 11648).

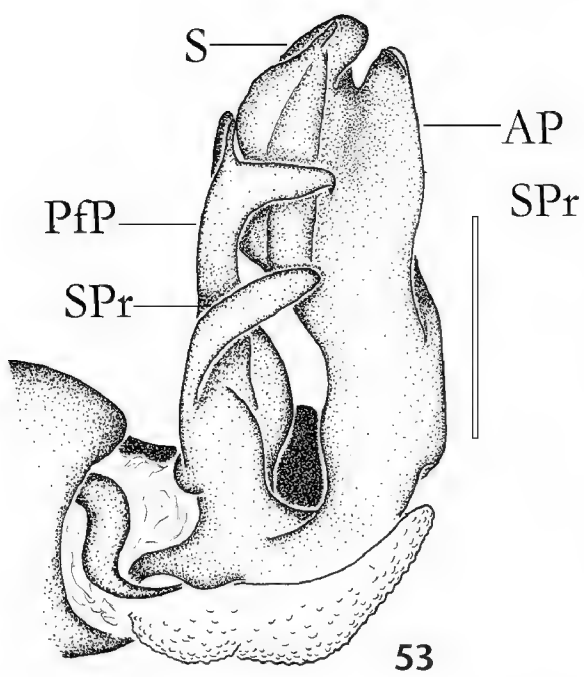
Description. Male (Holotype, MNRJ 11648). Coloration (long-preserved in 70% ethanol): Head brownish. Antennae white yellow. Body brown and paranota tip whitish. Legs brown-



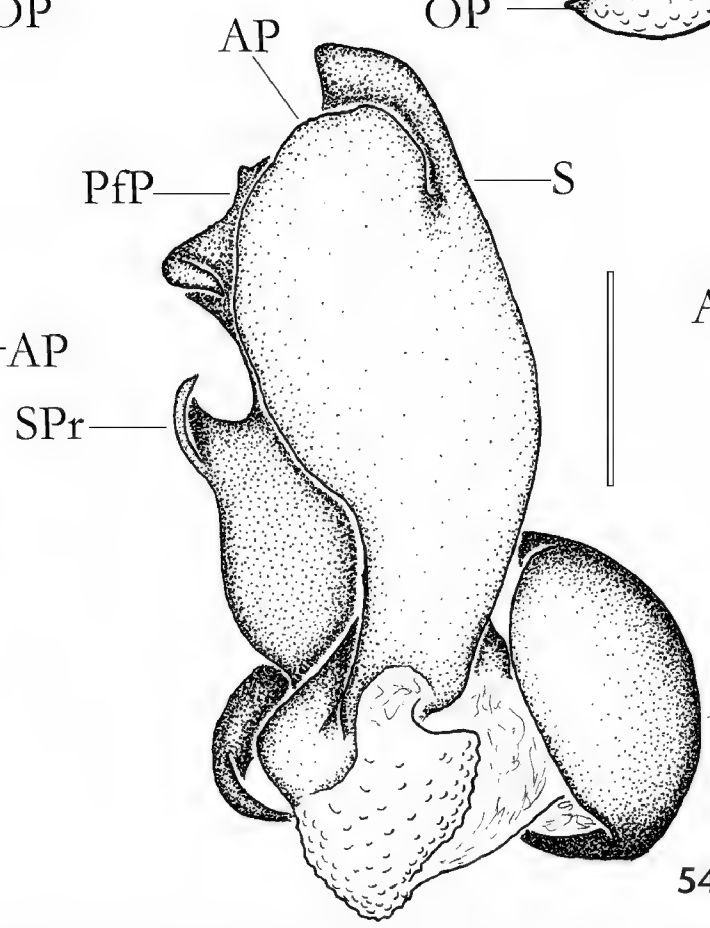
51



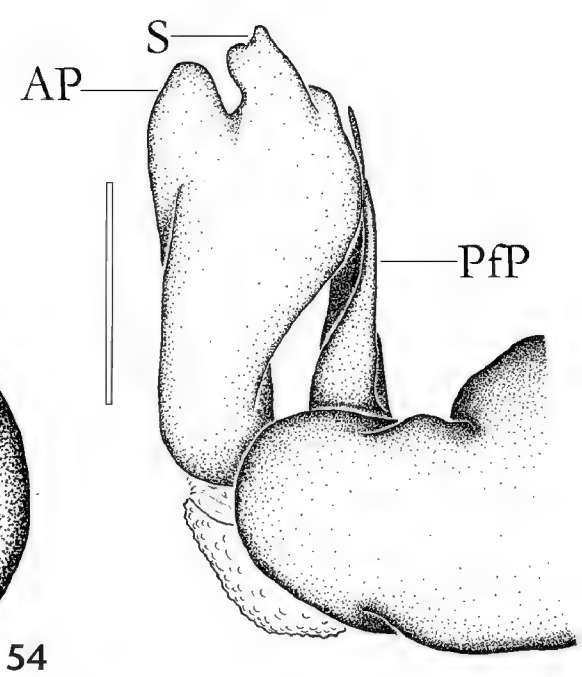
52



53



54



55

Figures 51–55. (51–52) *Eucampesmella brascubas* sp. nov., paratype, MZSP, left vulva: (51) ventral view; (52) lateral view. (53–55) *Eucampesmella iracema* sp. nov., holotype, MNRJ 11648, left gonopod: (53) mesal view; (54) ventral view; (55) ectal view. Scale bars: 51–52 = 700 µm, 53–55 = 800 µm.

ish. Body rings: cuticle rough; paranota with posterior edges rounded; ozopore posteriorly situated on paranota. Stigma oval. Sternite of body ring 4 with one pair of projections; Sternite of body ring 5 with two pairs of projections, the former ones are rectangular and the latter ones are triangular; Sternite of body ring 6 without projections but the anterior zone between the coxae have a cluster of setae. Pair of legs on body ring 3 with coxae possessing a rectangular-shaped genital papilla, and pairs of legs on body rings 5 to 17 with two pairs of slightly triangular projections between coxae. Gonopod aperture on body ring 7 elliptical, posterior edge with prominent folds, in anal view the posterior margin is rounded projected. Legs brownish, with a dorsal lobe in the prefemur. Telson brown with the posterior margin whitish.

Total length: 53.71. Width total: 8.71. Antennomere lengths (1>7): 0.71; 1.77; 1.60; 1.36; 1.54; 1.48; 0.26. Podomeres

lengths (1>7): 0.88; 1.08; 2.21; 1.15; 1.24; 1.62; 0.48. Gonopod aperture, long 2.01, width 3.71. Telson, long 1.59. Gonopod: long 3.07, width 2.80. Coxae: long 1.51, width 2.61. Telopodite: long 2.84, width 1.56.

Gonopods (Figs 53–55): coxae equivalent to about the length of the telopodite and prominent digitiform (= rectangular, rounded in the corners) in ectal view (Fig. 55). Coxae with a row of macrosetae on the dorsal side. Cannula: hook-shaped. Prefemoral region ventrally developed, about 1/3 length of telopodite; ending in a well-demarcated transition zone. Prefemoral process long, but not exceeding the acropodite; robust and broad, in dorsal view, except for the terminal branch that is internally curved; an internally curved secondary process arises in the medial portion (PfP; Figs 53, 54). Acropodite elongated, robust and broad; solenomere conducting the prostatic groove that opens on a small sharp projection in the apex of this branch (S; Figs 53–55); Acropodital process rounded and shield shaped, in ventral view (AP; Figs 53–55).

Female. Unknown.

Distribution. Only known for the type locality (Fig. 67).

Etymology. The species epithet is a reference to the Brazilian literature character "Iracema" from the book "Iracema" written by José de Alencar. Noun in apposition.

Eucampesmella pedrobala sp. nov.

Figs 56–60, 67

http://zoobank.org/6CC047E8-CAF9-4BA8-8A8E-F370EB36FDE3

Diagnosis. Males of *Eucampesmella pedrobala* sp. nov. differ from all other species of the genus by the apical portion of prefemoral process divided into two branches (Figs 56, 57), similar to *E. capitu* sp. nov. but with the same length, while in *E. capitu* sp. nov. the anterior branch is longer than the posterior. Apex of the solenomere small and rounded (Fig. 56). Acropodital process with irregular edges (Figs 57, 58).

Type material. Holotype: Male from Cachoeira do Calista, Rodovia BR 020, Parambu (6°12'31"S; 40°41'28"W), Ceará, Brazil, 19.III.1999, A.B. Kury & A. Giupponi coll. (MNRJ 11606). Paratype: One female from the same date and locality (MNRJ 30173).

Description. Male (Holotype, MNRJ 11606). Coloration (long-preserved in 70% ethanol): Head brownish. Antennae white yellow. Body brown and paranota tip whitish. Legs brownish. Body rings: cuticle rough; paranota with posterior edges rounded; ozopore posteriorly situated on paranota. Stigma oval. Sternite of body ring 4 with one pair of projections; Sternite of body ring 5 with two pairs of projections, the former ones are rectangular and the latter ones are triangular; Sternite of body ring 6 with one anterior pair of triangular projections. Pair of legs on body ring 3 with coxae possessing a rectangular-shaped genital papilla, and pairs of legs on body rings 5 to 17 with two pairs of slightly triangular projections between coxae. Gonopod aperture on body ring 7 elliptical, posterior edge with prominent folds, in anal view the posterior margin has a triangular projection. Legs brownish, with a dorsal lobe in the prefemur. Telson with the same color as the body.

Total length: 49.02. Width total: 7.67. Antennomere lengths (1>7): 0.66; 1.30; 1.22; 1.34; 1.51; 1.36; 0.27. Podomeres lengths (1>7): 0.67; 0.99; 2.03; 0.95; 1.05; 1.36; 0.36. Gonopod aperture, long 1.65, width 2.55. Telson, long 1.16. Gonopod: long 2.60, width 2.32. Coxae: long 0.99, width 1.69. Telopodite: long 2.56, width 1.12.

Gonopods (Figs 56–58): coxae equivalent to about half the length of the telopodite and prominent rectangular, in ectal view (Fig. 58). Coxae with a row of macrosetae on the dorsal side. Cannula: hook-shaped. Prefemoral region ventrally developed, about 1/3 length of telopodite; ending in a well-demarcated transition zone. Prefemoral process long; two terminal branches thin and slender, the proximal one slightly angulated and the apical one straight; a long and slender secondary process arises in the medial-basal portion, with almost the same length of the prefemoral process (PfP; Fig. 56). Acropodite elongated, robust and broad; Solenomere conducting the prostatic groove that opens on a small sharp projection in a small rounded apex (S; Fig, 56); Acropodital process with subtriangular shaped, with irregular edges, in ventral view (AP; Fig. 58).

Female (Paratype, MNRJ 30173). Coloration as in male. Posterior margin of vulvae opening with a large triangular-shaped epigyne. Vulvae (Fig. 59) elongated, slender and oval-shaped. Total length: 54.13. Width total: 8.17. Posterior margin of the vulvae aperture: 2, 31 width. Vulvae: long 2.24, width 0.66. External valve: long 2.02, width 0.25. Internal valve: long 1.99, width 0.30. Operculum: long 0.30, width 0.42. Lateral margin of the both valves with long setae and densely setose, central setae short and scattered (IV, Figs 59, 60). Operculum small (OP, Figs 59, 60).

Distribution. Only know for the type locality (Fig. 67).

Etymology. The species epithet is a reference to the Brazilian literature character "Pedro Bala" from the book "Capitães da Areia" written by Jorge Amado. Noun in apposition.

Eucampesmella lalla sp. nov.

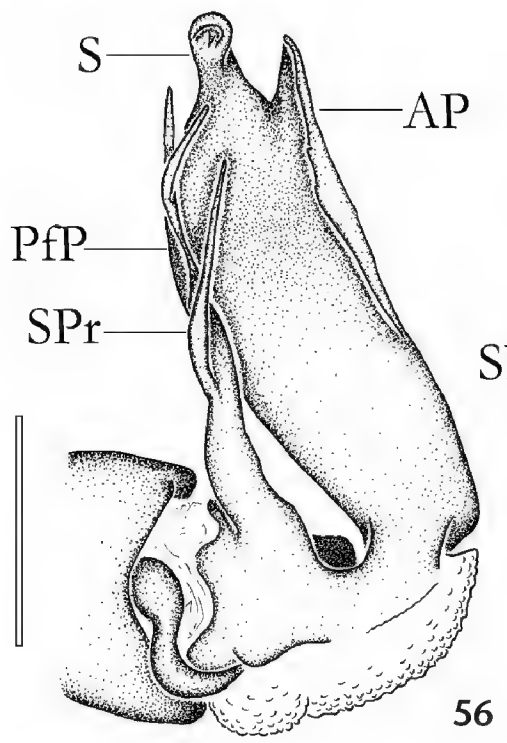
Figs 61–65, 67

http://zoobank.org/A76EE763-F0B6-491E-8B70-FDDC52520759

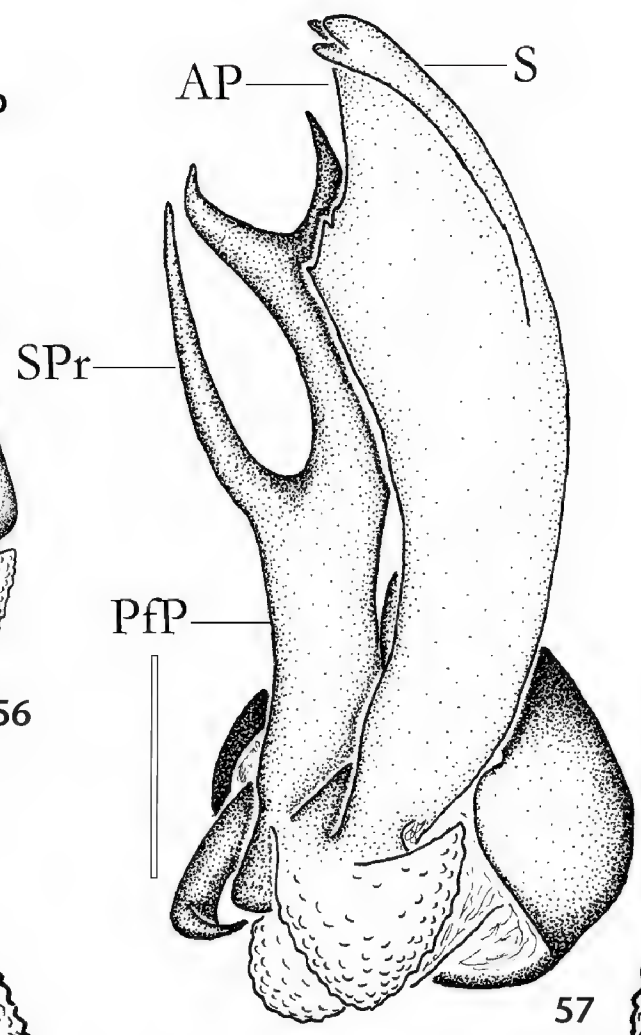
Diagnosis. Males of *Eucampesmella lalla* sp. nov. differ from all other species of the genus by the prefemoral process with a small lateral spine on the middle region of the process (Figs 61, 62). Just above the median region of the prefemoral process, on the inner margin, there is an irregular zone with some indentations (Fig. 61).

Type material. Holotype: Male from Parque das Dunas (5°50'03"S; 35°11'25"W), Natal, Rio Grande do Norte, Brazil, 02.II.2002, Fernando coll. (IBSP 1378). Paratypes: One female from the same date and locality (IBSP 1378).

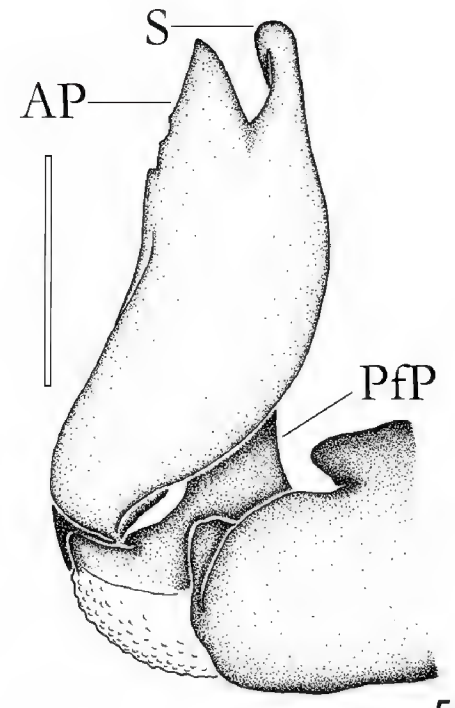
Description. Male (Holotype, IBSP 1378). Coloration (long-preserved in 70% ethanol): Head ocher. Antennae yellow-



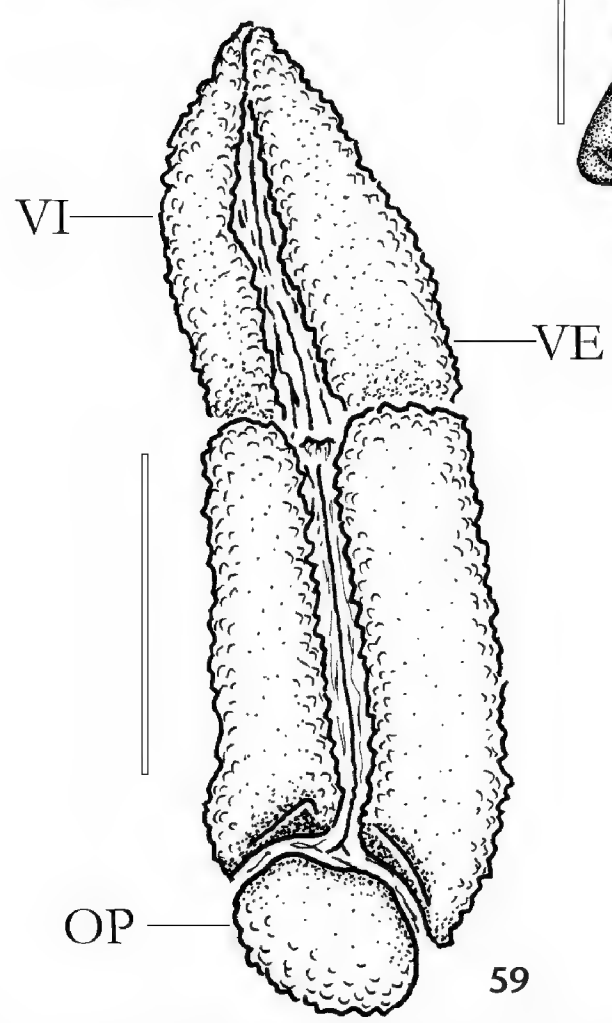
56



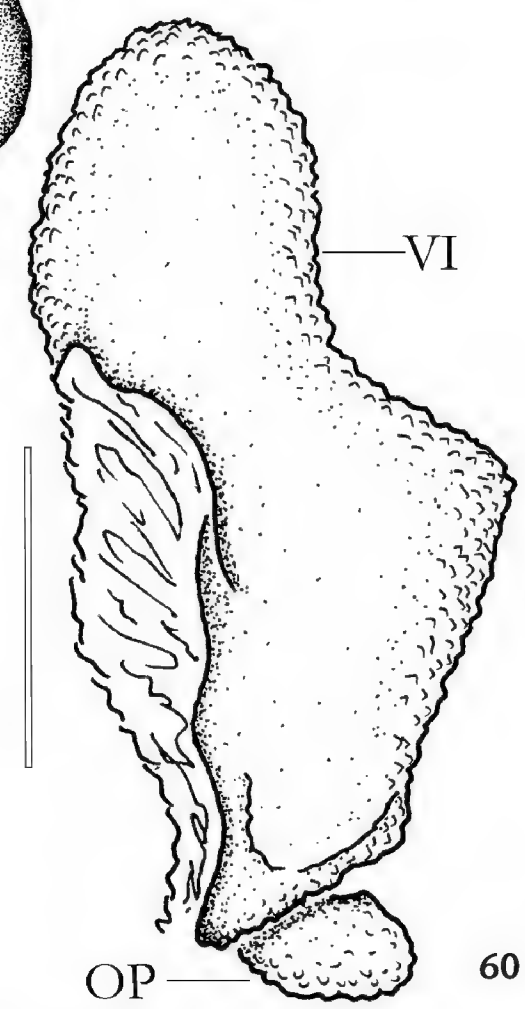
57



58



59

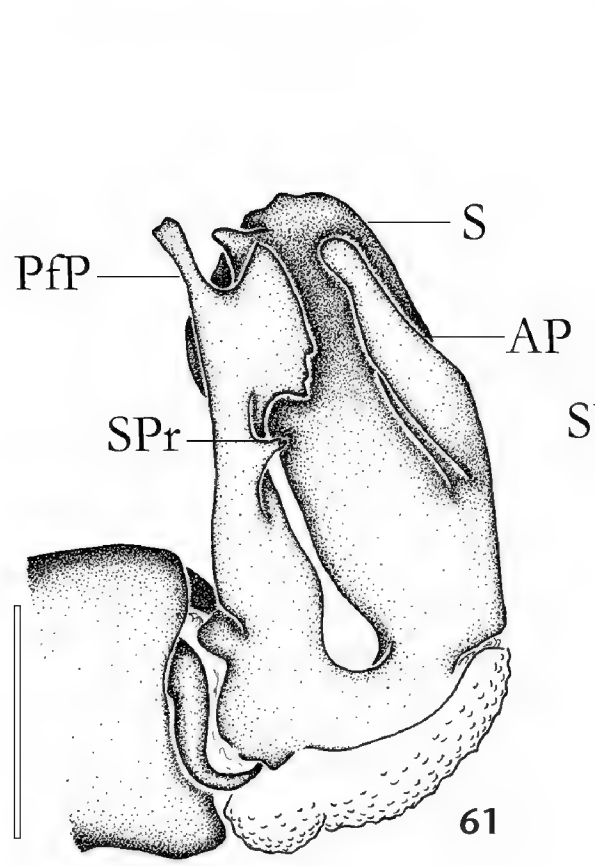


60

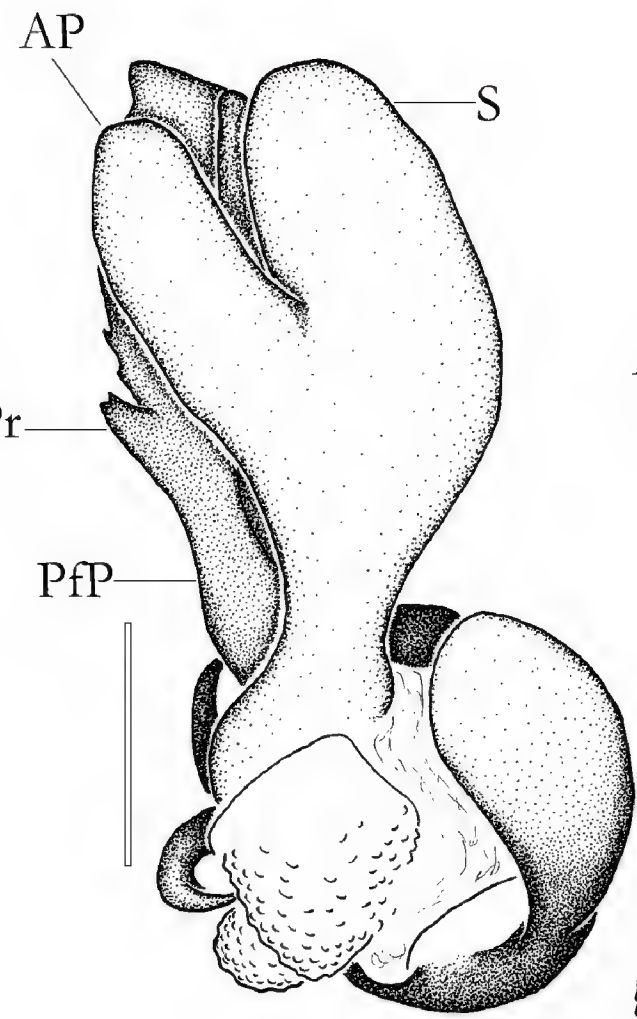
Figures 56–60. *Eucampesmella pedrobala* sp. nov. (56–58) Holotype, MNRJ 11606, left gonopod: (56) mesal view; (57) ventral view; (58) ectal view. (59–60) Paratype, MNRJ 30173, left vulva: (59) ventral view; (60) lateral view. Scale bars: 56–60 = 800 µm, 59–60 = 700 µm.

ish white. Body brown and paranota tip yellowish. Body rings: cuticle rough; paranota rounded; ozopore central-posteriorly situated on paranota; peritremata slightly pronounced on the paranota. Stigma oval. Sternite of body ring 4 with one pair of projections; Sternite of body ring 5 with two pairs of projections, the former ones are larger and rounded-shaped, the latter ones are triangular; Sternite of body ring 6 with two pairs of small triangular projections in the base of the coxae; post-gonopodal sternites with two pairs triangular projections; Sternite until the body ring 9 with the anterior zone between the coxae showing a cluster of small setae. Pair of legs on body ring 3 with coxae possessing a rectangular-shaped genital papilla. Gonopod aperture on body ring 7 elliptical, posterior edge with prominent folds, in anal view the posterior projecting margin is rounded. Legs yellowish, with a dorsal lobe on the prefemur and tibia, some legs with granules. Telson brown with the posterior margin whitish.

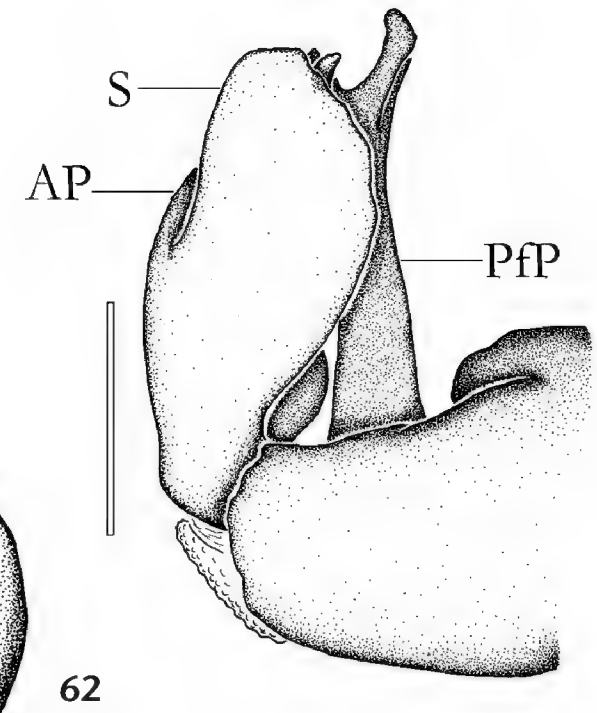
Total length: 61.16. Width total: 10.34. Antennomere lengths (1>7): 0.67; 1.80; 1.36; 1.43; 1.64; 1.33; 0.22. Podomeres lengths (1>7): 0.65; 1.46; 2.45; 1.34; 1.55; 1.56; 0.48. Gonopod aperture, long 2.60, width 4.57. Telson, long 1.00. Gonopod:



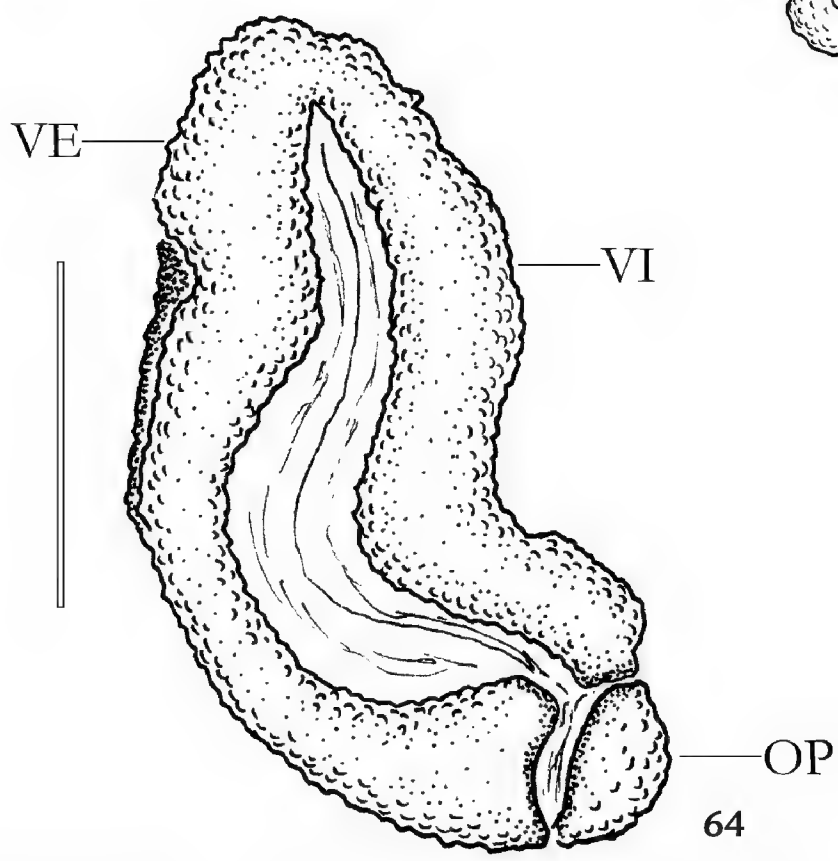
61



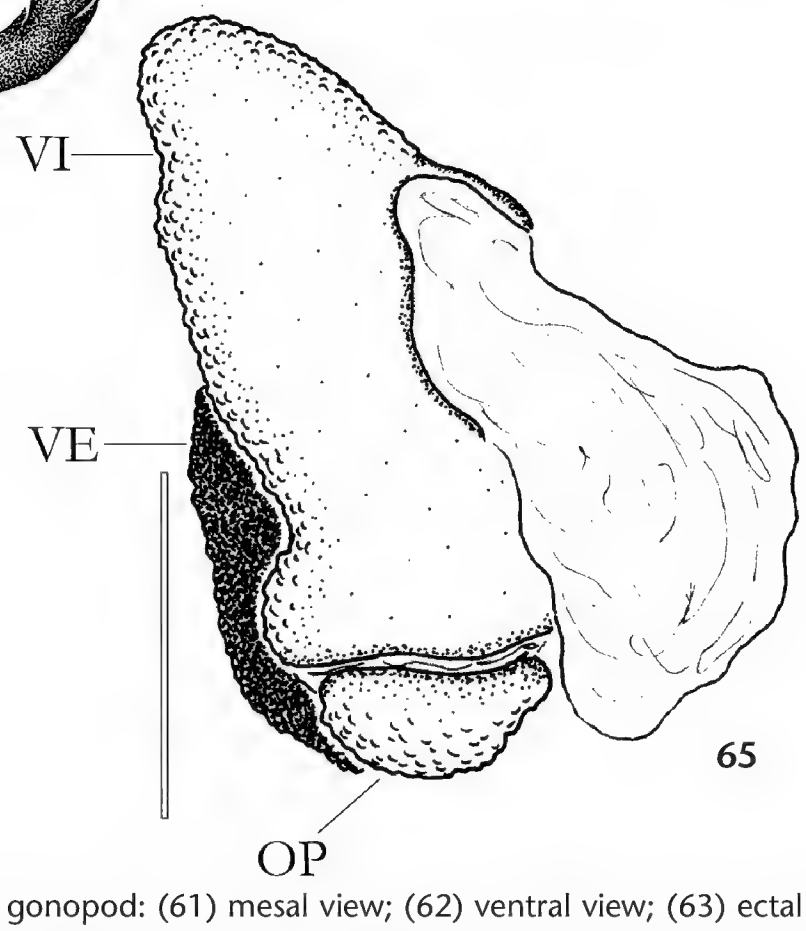
62



63



64



65

Figures 61–65. *Eucampesmella lalla* sp. nov. (61–63) Holotype, IBSP 1378, left gonopod: (61) mesal view; (62) ventral view; (63) ectal view. (64–65) Paratype, IBSP 1378, left vulva: (64) ventral view; (65) lateral view. Scale bars: (61–63 = Scale bars: 1 mm, 64–65 = 700 µm.

long 3.93, width 3.90. Coxae: long 1.88, width 2.94. Telopodite: long 3.67, width 1.77.

Gonopods (Figs 61–63): coxae equivalent to about the length of the telopodite and prominent digitiform (= rectangular, with rounded corners) in ectal view (Fig. 63). Coxae with a row of macrosetae on the dorsal side. Cannula: hook-shaped. Prefemoral region ventrally developed, about 1/3 length of the telopodite; ending in a well-demarcated transition zone. Prefemoral process long, slightly exceeding the length of the acropodite; broad, in dorsal view; indentation border is present in the sub-apical portion on the external margin of the process; a small spine-shaped secondary process arises in the medial portion (PfP; Figs 61, 62). Acropodite elongated, robust and broad; apical portion divided; Solenomere conducting the prostatic groove that opens on a conspicuous acute projection; solenomere robust and rounded shaped (S; Figs 61–63); Acropodital process more slender than the solenomere, sub-oval in ventral view (AP; Figs 61–63).

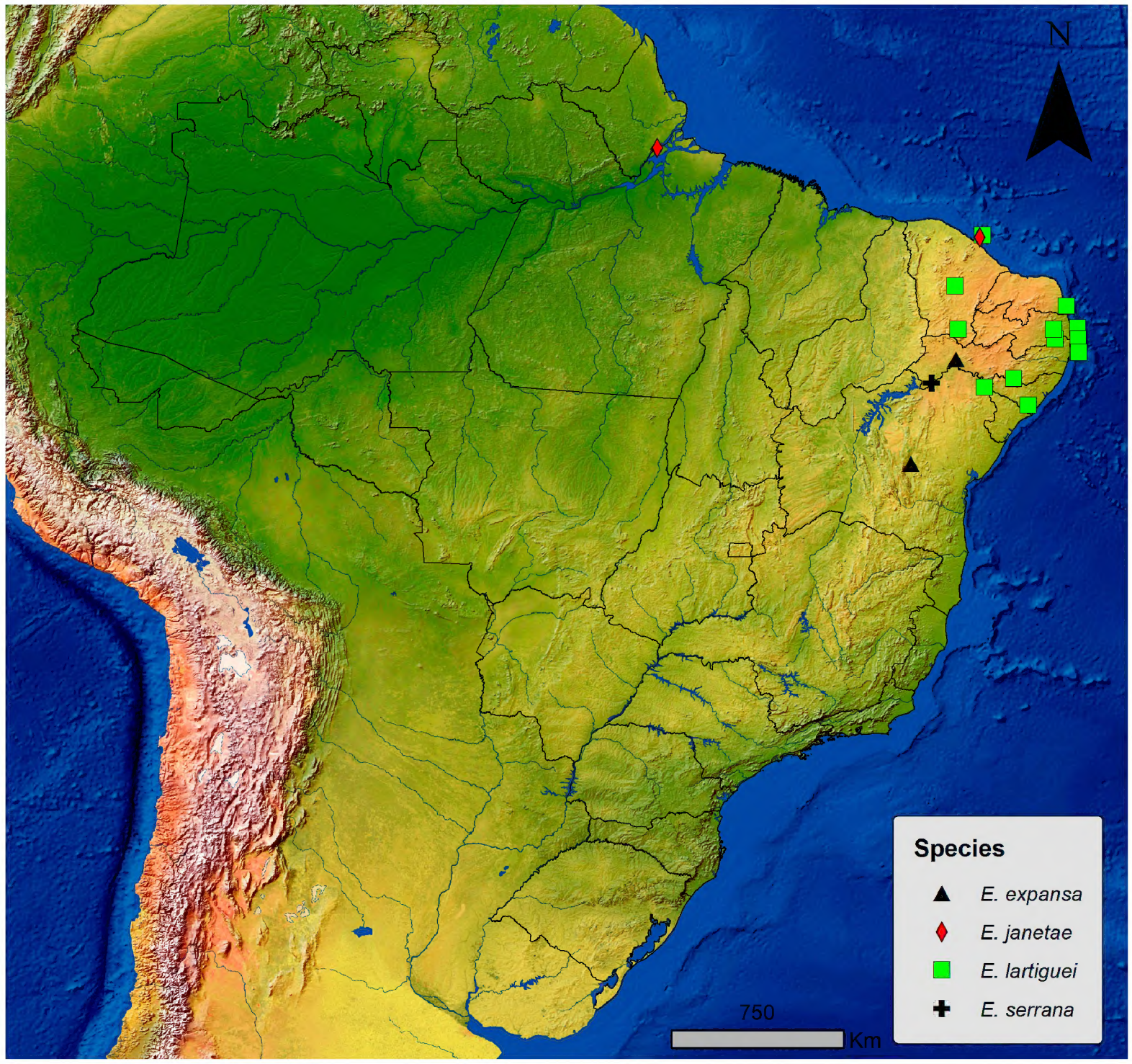


Figure 66. Distribution map of *Eucampesmella* species.

Female (Paratype, IBSP 1378). Head and body dark brown, paranota tip yellowish. Posterior margin of vulvae opening presenting a small dome-shaped epigyne. Vulvae (Fig. 64) elongated; not straight (=curved to the external side; "C-shaped"). Total length: 63.14. Width total: 9.28. Posterior margin of the vulvae aperture: 2, 93 width. Vulvae: long 1.93, width 1.15. External valve: long 1.91, width 0.86. Internal valve: long 1.49, width 0.69. Operculum: long 0.28, width 0.46. Latero-posterior margin of the both valves with long setae and densely setose, central setae shorter and scattered; a depression occurs along all the central portion of both valves (Fig. 65). Operculum small (OP, Figs 64, 65).

Distribution. Only known for the type locality (Fig. 67).

Etymology. The species epithet is taken as a noun in apposition honoring the chilopodologist Laura Del Latte, nicknamed "Lalla", for her contributions to science and a very important person in life for the third author.

Incertae sedis Species

Eucampesmella pugiuncula (Schubart, 1946)

Leptodesmus pugiunculus Schubart, 1946: 184, fig. 12 (Male holotype from Monte Christo, Rio Tapajós, Amazonas, Brazil, 1921, E. Garbe coll., deposited in MZSP, examined).
Eucampesmella pugiuncula: Hoffman, 1967: 188.

Remarks. As discussed by Hoffman (1967), *E. pugiuncula* differs from the genus diagnosis by having prefemoral process small and slender; acropodite region with a secondary process distally.

Distribution. State of Amazonas, Brazil.

Eucampesmella schubarti Kraus, 1957

Eucampesmella schubarti Kraus, 1957: 96, plate 7, figs 7-10 (Male holotype and female paratype from Cordillera Azul, Sinchono, Huánuco, Peru, 1500 m, vii.1947. W. Weyrauch coll., deposited in SMF 2688, examined).

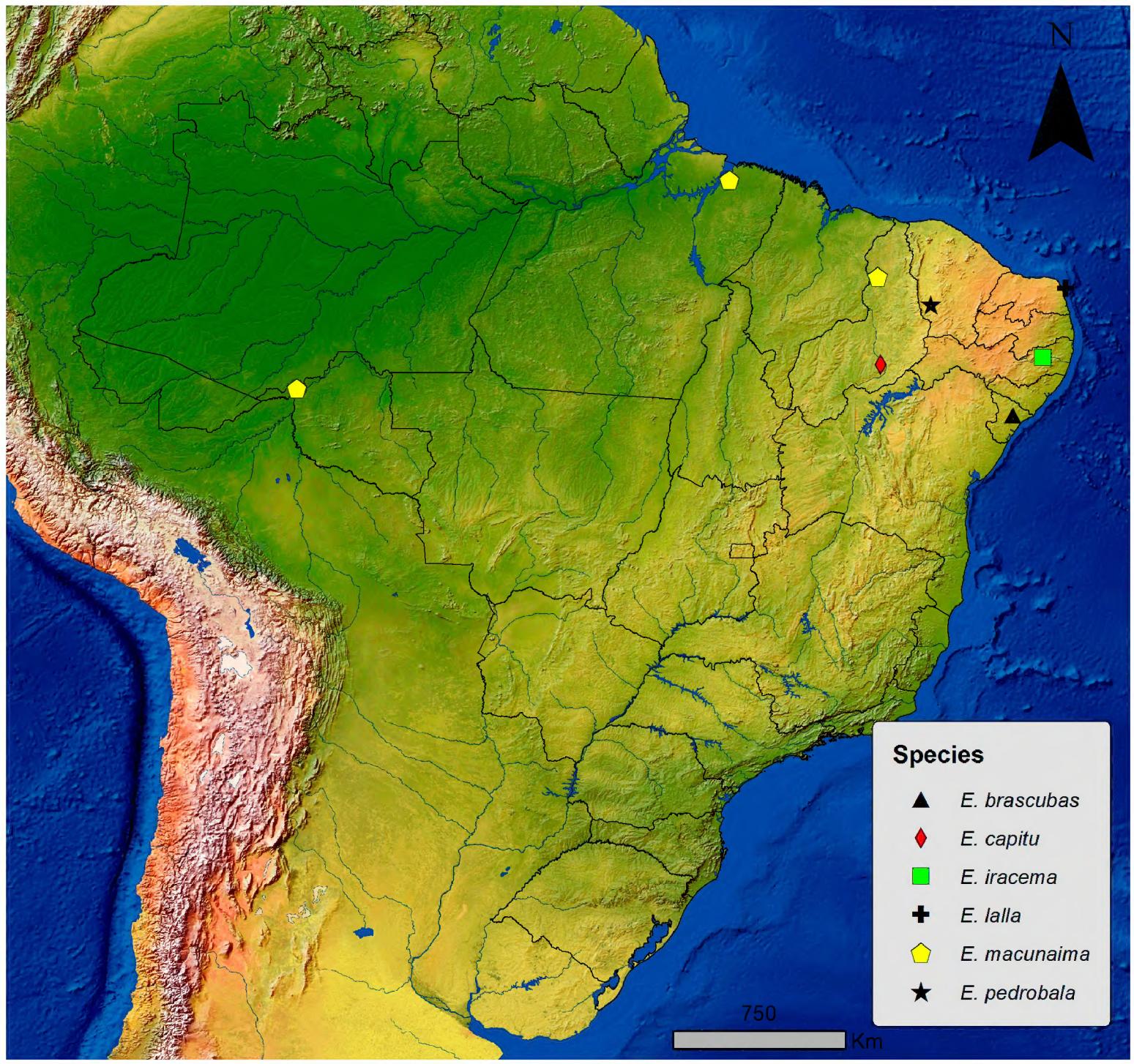


Figure 67. Distribution map of *Eucampesmella* species.

Remarks. The species is not a member of the genus due to the following features: solenomere and acropodital process divided at the base of the acropodital region; prefemoral process small and slender, without a secondary projection. Additionally, *E. schubarti* was not mentioned in the list of species of the genus (see Hoffman 1967).

Distribution. Peru.

Eucampesmella brunnea Kraus, 1959

Eucampesmella brunnea Kraus, 1959: 196, plate 20, figs 10-12 (Male holotype from Rio Tarma, Pan de Azucar, Ucayali, Peru, 1400m, 15.x.1956, W. Weyrauch coll., deposited in SMF 3727, examined).

Remarks. The species is not a member of the genus due to the following features: solenomere and acropodital process divided at the base of the acropodital region; prefemoral process small and slender, without a secondary projection. Additionally, *E. brunnea* was not mentioned in the list of species of the genus (see Hoffman 1967).

Distribution. Peru.

DISCUSSION

The female genitalia of Chelodesmidae had not been taken into consideration in systematic contributions on diplopods. The absence of complex branches and processes in the different parts of the vulvae and the "simple" design of the female genitalia seem to suggest, at first, that it does not provide diagnostic characters. The easy access to species-specific genital characters in males (e.g. gonopod) reinforced the trend to ignore the vulvae in taxonomic treatments (Hoffman 1967).

Even though some Chelodesmid species have been described based solely on female specimens, these species present strongly conspicuous somatic characters (for instance, color pattern on body rings; shape of paranota) (e.g. Schubart 1945, 1960). Importantly, descriptions based only on female material are not recommended, since the taxonomy of the family is mostly based on the morphology of the gonopod. Nevertheless, characters from vulvae have been used in previous cladistic

analyzes (see Pena-Barbosa et al. 2013, Bouzan et al. 2019b), which have recovered important information at the generic level. Based on the literature and observation of several groups of Chelodesmidae, the female genitalia seem to provide important diagnostic character for the generic (e.g. Pena-Barbosa et al. 2013, Bouzan et al. 2017, 2020) or supra-generic (Hoffman 1990a, 1990b) classification.

The females of most species of *Eucampesmella* remain undescribed. The descriptions of new species presented here show common pattern for the genus, a well-exposed and elongated vulvae. This pattern is unusual among the Chelodesminae. According to Pena-Barbosa (unpublished data), the character state "vulva elongated" was recovered independently at least three times in the subfamily: in *Parastenonia aurae* and *Cearodesmus gomesi* (Priodesmini), Macrocoxodesmini + Telonychopodini, and *Cornalatus tabulus* (Cornalatini). This homoplastic synapomorphy indicates that there is a relationship between *Eucampesmella lartiguei ferrii* and other members of Telonychopodini, corroborating the results of Pena-Barbosa et al. (2013).

Eucampesmella was first assigned to Telonychopodini (Hoffman, 1980) and subsequently transferred to Macrocoxodesmini by Golovatch and Hoffman (2004), citing the relationship between the genus with *Macrocoxodesmus*, also discussed in Hoffman (1990a). Macrocoxodesmini, as defined by Golovatch and Hoffman (2004), was not recovered in the phylogenetic analysis of Pena-Barbosa et al. (2013). *Eucampesmella* was recovered as a sister-group of Telonychopodini, whereas the relationship of *Macrocoxodesmus* to *Rondonaria* + *Odontopeltis* was well-supported. In addition, the structure of the gonopodal aperture in *Eucampesmella* is similar to the condition found in members of Telonychopodini (Hoffman 1965, 2000, 2005, Pena-Barbosa et al. 2013). Concerning the female characters, *Macrocoxodesmus marcusi* has a modified legpair associated with the vulva, a condition only known in *Macrocoxodesmus* and *Plectrogonodesmus gounellei* (Bouzan et al. 2019a). Further studies are still required to confirm the tribal position of *Eucampesmella*. Characters of the vulvae (and other female characters) may play a key role in solving these issues.

Golovatch and Hoffman (2004) recorded the occurrence of *E. janetae* in Amapá, besides suggesting that the generic distributional range of the genus encompasses Minas Gerais, Sergipe, Ceará, Pará and Maranhão. This is partially corroborated by *E. macunaima* sp. nov., *E. brascubas* sp. nov., and *E. pedrobala* sp. nov., distributed in the states of Rondônia, Pará and Piauí. Two hypotheses for the widely distribution of *Eucampesmella* are proposed: 1) disjunct records are an artifact of insufficient collecting; or 2) accidental introduction may have happened, possibly connected with agricultural activities.

ACKNOWLEDGEMENTS

We are grateful to Edmund Schiller for providing photos of the type specimens housed in NHMW; Leonardo Carvalho for sending us specimens, and Raphael Indicatti for sending pictures of live specimens. We are also in debt to Ricardo Pinto da Rocha and Mauro Cardoso Junior (MZSP) for their help numbering the specimens and the loan of the study material. Thanks also to Beatriz Mauricio for helping with the SEM images in the Laboratório de Biologia Celular of Instituto Butantan, and to Petra Sierwald for critical readings of the English version. We are also grateful to the reviewers and the editor for their valuable comments. This study was supported by Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (CAPES, 88887.510007/2020-00) grant to RSB; Fundação de Amparo à Pesquisa do Estado de São Paulo (FAPESP) grant to RSB (2018/00103-8) and LFMI (2016/24248-0); ADB by the grant Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq, 303903/2019-8). This study was financed in part by the Coordenação de Aperfeiçoamento de Pessoal de Nível Superior, Brasil (CAPES, Finance Code 001).

LITERATURE CITED

Ah-King M, Barron AB, Herberstein ME (2014) Genital evolution: why are females still understudied? PLoS Biology 12: e1001851. https://doi.org/10.1371/journal.pbio.1001851

Attems CG (1898) System der Polydesmiden. I. Theil. Denkschriften der Kaiserlichen Akademie der Wissenschaften zu Wien, Mathematisch-Naturwissenschaftliche Classe 67: 221–482.

Attems CG (1931) Die Familie Leptodesmidae und andere Polydesmiden. Zoologica, Stuttgart (79): 1–150.

Attems CG (1938) Myriapoda 3. Polydesmoidea II. Fam. Leptodesmidae, Platyrhachidae, Oxydesmidae, Gomphodesmidae. Das Tierreich 69: 1–487.

Attems CG (1944) Neue Polydesmoidea. Zoologischer Anzeiger, Leipzig 144 (11-12): 223–251.

Bouzan RS, Iniesta LFM, Brescovit AD (2019b) Cladistic analysis and description of a new species of the Brazilian genus *Atlantodesmus* Hoffman, 2000 (Diplopoda: Polydesmida: Chelodesmidae). European Journal of Taxonomy, 538: 1–17. https://doi.org/10.5852/ejt.2019.538

Bouzan RS, Pena-Barbosa JPP, Brescovit AD (2017) Taxonomic review of the genus *Atlantodesmus* Hoffman, 2000 (Polydesmida: Chelodesmidae). Zootaxa 4236(2): 269–290. https://doi.org/10.11646/zootaxa.4236.2.3

Bouzan RS, Iniesta LFM, de Souza CAR, Brescovit AD (2019a) A new record after a century and description of the female of *Plectrogonodesmus gounellei* (Brölemann 1902) (Polydesmida: Chelodesmidae). Studies on Neotropical Fauna and Environment 54(1): 61–68. https://doi.org/10.1080/01650521.2018.1536018

Bouzan RS, Iniesta LFM, de Souza CAR, Zampaulo RA, Brescovit AD (2020) Taxonomic review of the Amazonian millipede genus *Parastenonia* Hoffman, 1977 and description of a new species from iron-ore caves (Polydesmida: Chelodesmidae). Journal of Natural History 53: 2781–2799. https://doi.org/10.1080/00222933.2020.1749956

Brölemann HW (1903) Myriapodes recueillis au Pará par Monsieur le Prof. E. A. Goeldi, Directeur du Musée. Zoologischer Anzeiger, Leipzig 26(691): 177–191.

Brölemann HW (1909) Os myriapodos do Brazil. Catalogos da Fauna Brazileira 2: 1–94.

Chamberlin RV (1952) An arrangement of the Prepodesmidae, a family of African millipeds. Journal of the Washington Academy of Sciences 42(10): 327–333.

Enghoff H, Golovatch SI, Short M, Stoev P, Wesener T (2015) Diplopoda – taxonomic overview. In: Minelli A (Ed.) Treatise on Zoology - Anatomy, Taxonomy, Biology. The Myriapoda. Brill, Leiden, vol. 2. https://doi.org/10.1163/9789004188273_017

Golovatch SI, Hoffman RL (2004) On two new chelodesmid millipedes from Amapá, Brazil (Diplopoda, Polydesmida, Chelodesmidae). Amazoniana 18(1/2): 49–55.

Hoffman RL (1953) The identity of the milliped genus *Camptomorpha* Silvestri (Polydesmida: Chelodesmidae). Entomological News 64(5): 120–124.

Hoffman RL (1965) The status of the milliped *Telonychopus meyeri* Verhoeff, and of the family name Telonychopidae. Papéis Avulsos do Departamento de Zoologia 17(19): 243–253.

Hoffman RL (1967) The identity of *Cordyloporus sulcatus* Attems, 1898: another diplopod riddle solved. Entomologische Mitteilungen aus dem Zoologischen Staatsinstitut und Zoologischen Museum Hamburg 3(59): 183–189.

Hoffman RL (1980) Classification of the Diplopoda. Múseum d'histoire naturelle, Genève, 237 pp.

Hoffman RL (1990a) Chelodesmid studies XXIII. Proposal of a new tribe for the disjunct Brasilian genus *Macrocoxodesmus* (Diplopoda, Polydesmida, Chelodesmidae). Papéis Avulsos de Zoologia 37(11): 167–172.

Hoffman RL (1990b) Chelodesmid studies XX. Millipeds of the new Brazilian tribe Cornalatini (Polydesmida: Chelodesmidae). Papéis Avulsos de Zoologia, São Paulo 37(2): 23–37.

Hoffman RL (2000) A synopsis of the Telonychopodini, a tribe of Pantanalian chelodesmid millepeds (Polydesmida: Chelodesmidae). Myriapodologica 7(1): 1–13.

Hoffman RL (2005) Another new telonychopine genus from western Brazil (Polydesmida: Chelodesmidae). Myriapodologica 8(6): 59–65.

Koch M (2015) General morphology. In: Minelli A (Ed.) Treatise on Zoology – Anatomy, Taxonomy, Biology. The Myriapoda. Brill, Leiden, vol. 2. https://doi.org/10.1163/9789004188273_003

Kraus O (1957) Myriapoden aus Peru, V. Senckenbergiana Biologica 38: 95–114.

Kraus O (1959) Myriapoden aus Peru, VII. Senckenbergiana Biologica 40(3–4): 191–208.

Pena-Barbosa JPP, Sierwald P, Brescovit AD (2013) On the largest chelodesmid millipedes: taxonomic review and cladistic analysis of the genus *Odontopeltis* Pocock, 1894 (Diplopoda, Polydesmida, Chelodesmidae). Zoological Journal of the Linnean Society 169: 737–764. https://doi.org/10.1111/zoj.12086

Schubart O (1945) Os Proterospermophora do Distrito Federal (Myriapoda, Diplopoda). Arquivos do Museu Nacional, Rio de Janeiro, 38: 1–156.

Schubart O (1946) Contribuição ao conhecimento do gênero *Leptodesmus* (Família Leptodesmidae, Diplopoda). Anais da Academia Brasileira de Ciências 18: 165–202.

Schubart O (1948) Diplópodos nordestinos. II. Família "Leptodesmidae". Revista Brasileira de Biologia 8(1): 87–92.

Schubart O (1955) Materiais para uma fauna do estado de São Paulo, Os Leptodesmidae. Arquivos do Museu Nacional Arquivos do Museu Nacional 42: 507–540.

Schubart O (1956) "Leptodesmidae" Brasileiras. IV: Espécies novas da Bahia (Diplopoda, Proterospermophora). Revista Brasileira de Biologia 16(4): 421–428.

Schubart O (1960) Leptodesmidae Brasileiras. VIII. Novas espécies do Estado de São Paulo (Diplopoda, Proterospermophora). Revista Brasileira de Biologia 20(4): 453–464.

Silvestri F (1897) Description des espèces nouvelles de myriapodes du Musée royal d'Histoire naturelle de Bruxelles. Annales de la Société Entomologique de Belgique 41: 345–362.

Weidner H (1960) Die Entomologischen Sammlungen des Zoologischen Staatsinstituts und Zoologischen Museums Hamburg. III. Teil. Chilopoda und Progoneata. Mitteilungen des Hamburgischen Zoologischen Museums und Instituts 58: 57–104.

Weidner H (1974) Die Entomologischen Sammlungen des Zoologischen Instituts und Zoologischen Museums der Universität Hamburg. III. Teil (Nachtrag). Chilopoda und Progoneata. Mitteilungen des Hamburgischen Zoologischen Museums und Instituts 70: 105–118.

Zahnle XJ, Sierwald P, Ware S, Bond JE (2020) Genital morphology and the mechanics of copulation in the millipede genus *Pseudopolydesmus* (Diplopoda: Polydesmida: Polydesmidae). Arthropod Structure & Development 54: 100913. https://doi.org/10.1016/j.asd.2020.100913

Submitted: March 22, 2021
Accepted: June 15, 2021
Available online: July 12, 2021
Editorial responsibility: Ricardo Pinto da Rocha

Authors' contribution: JPPPB, RSB & ADB conceived the idea; JPPPB and RSB analyzed all type materials of species already described. ADB contributed collected in the field. RSB described the new species. RSB and LFMI carried out the microscope work and wrote the manuscript with support from ADB. RSB, LFMI & ADB discussed the results and to the final manuscript.
Competing interests: The authors have declared that no competing interests exist.
© 2021 Sociedade Brasileira de Zoologia. Published by Pensoft Publishers at https://zoologia.pensoft.net